Regulation and competition policy in the ICT sector : essays in industrial organization

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INSTITUT DES SCIENCES ET TECHNOLOGIES
PARIS INSTITUTE OF TECHNOLOGY

TELECOM ParisTech

2013-ENST-0024

EDITE - ED 130

Doctorat ParisTech

T H È S E

pour obtenir le grade de docteur délivré par

TELECOM ParisTech

Spécialité « Sciences Économiques »

présentée et soutenue publiquement par

Germain GAUDIN

le 24 avril 2013

Régulation et politique de la concurrence dans le secteur des TIC : Éssais d'économie industrielle

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TELECOM ParisTech

Ecole Doctorale Informatique, Télécommunications et Electronique (Paris)

Regulation and competition policy in the ICT sector: Essays in industrial organization

Doctorate thesis,

Speciality: Economics

defended by

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April 2013, 24th

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Remerciements

Je tiens à remercier Marc Bourreau pour avoir encadré cette thèse de doctorat. Durant ces quelques années, il a su (je l'espère!) m'inculquer son sens de la rigueur académique et du travail bien fait. De plus, il a toujours été disponible, et a su faire preuve d'une grande didactique, ainsi que d'une certaine compréhension. Même si je n'ai pas de point de comparaison, je le recommande vivement en tant que directeur de thèse!

Je tiens à remercier sincèrement les enseignants-chercheurs qui m'ont fait l'honneur d'accepter d'être membres du jury de cette thèse: Jérôme Pouyet et Tommaso Valletti, rapporteurs de cette thèse, ainsi que Carlo Cambini et François Lévêque, examinateurs.

Je remercie tout particulièrement Alexander White, qui m'a professionnellement beaucoup apporté tout au long de cette thèse.

Je remercie mes co-auteurs, Maya Bacache et Claudia Saavedra (ainsi que Marc Bourreau et Alexander White, une nouvelle fois). Travailler à leurs côtés fut un réel plaisir, tout autant instructif que convivial. J'espère que nous aurons l'occasion de travailler ensemble à nouveau.

Je remercie mes collègues du Département SES de Télécom ParisTech, aux côtés de qui j'ai passé de très bons moments, professionels et amicaux, ces dernières années. J'ai notamment eu la chance, au sein du Département SES de Télécom ParisTech, de bénéficier d'un cadre de travail idéal pour mener à bien mes travaux.

Je remercie Martin Peitz de m'avoir accueilli pour quelques mois à l'université de Mannheim dans des conditions optimales pour la recherche, dans une ambiance très sympathique.

Je remercie également Léo Gaudin, Romain Lestage et Anne Plouët pour la relecture de certains chapîtres de cette thèse.

Enfin, je souhaite remercier tous les chercheurs qui ont pu faire avancer ma réflexion et qui m'ont fait des critiques constructives sur mes travaux. Je pense notamment aux chercheurs rencontrés lors des divers conférences et séminaires où j'ai pu présenter ces travaux.

Résumé

Cette thèse aborde certaines caractéristiques des politiques de régulation et de la concurrence dans le secteur des Technologies de l'Information et de la Communication (TIC). Plusieurs problématiques de régulation ex-ante sont abordées, traitant de l'investissement dans les infrastructures de réseaux fixes de télécommunications et de la mise en place de tests de ciseaux tarifaires par les autorités de régulation du secteur des télécommunications en Europe. Sont également étudiées différentes problématiques de politique de la concurrence, comme l'impact de la vente liée de produits créant des coûts de changement pour les utilisateurs ou la prise en compte des terminaux d'accès pour l'analyse du marché du livre électronique en droit de la concurrence. Les impacts de la régulation sectorielle sur la politique de la concurrence sont également analysés, avec une application à la définition et la gestion par les autorités de concurrence de la pratique de ciseau tarifaire dans les industries de réseaux. Enfin, cette thèse met en perspective différents avantages et inconvénients des interventions ex-ante et ex-post, respectivement par les autorités de régulation sectorielle et de concurrence.

Abstract

This thesis approaches several distinctive features of regulation and competition policy in the Information and Communications Technology (ICT) sector. It tackles some issues in ex-ante regulation on investment in new fixed telecommunications network infrastructures, and the application of margin squeeze tests by European regulatory authorities in the telecommunications industry. It also analyzes issues related to ex-post competition policy, such as the impact of bundling products with switching costs, or the competition authorities' investigations in the electronic book market. Further analysis on the impact of ex-ante regulation on ex-post competition policy is provided, in particular via studies on the definition of a margin squeeze conduct in network industries, and how competition authorities deal with it. Finally, this thesis evaluates several advantages and weaknesses of both ex-ante regulatory authorities' and ex-post competition authorities' interventions.

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Résumé étendu de la thèse en français

1.1 Introduction

Ce manuscrit de thèse de doctorat en économie industrielle et les articles de recherche qui le constituent sont écrits en anglais. Cette première partie du manuscrit vise à donner un résumé de chaque chapitre de cette thèse dans la langue de Molière. Une version plus détaillée se trouve dans les parties et chapitres suivants.

1.1.1 Régulation et politique de la concurrence dans le secteur des TIC

Le secteur des Technologies de l'Information et des Communications (TIC) correspond, selon l'Organisation pour la Coopération et le Développement Economique (OCDE), à tout ce qui capture, transmet, et expose des données et de l'information par voie électronique. Etudier et analyser ce secteur avec les outils de l'économie industrielle est une entreprise tout à fait fascinante. En effet, non seulement ce secteur est en constante mutation et bénéficie régulièrement d'avancées technologiques majeurs qui remettent en cause toute son organisation, mais il constitue aussi un terrain propice au développement d'organisation industrielle particulières, souvent dues aux relations verticales entre firmes ou aux économies d'échelle.

Les particularités de ce secteur se traduisent sous plusieurs formes. L'une d'elles est qu'un certain nombre de marchés du secteur des TIC sont régulés ex-ante par des autorités administratives de régulation sectorielle, tout en étant sujet à une régulation ex-post par des autorités de concurrence.

Dans cette thèse, j'étudie certains aspects de la régulation dans le secteur des télécommunications, puis certains comportements stratégiques des firmes pouvant se heurter à la politique de la concurrence et les règles qui en découlent. Enfin, j'étudie l'interaction entre régulation ex-ante et politique de la concurrence ex-post en me penchant sur les effets de ciseaux tarifaires.

1.1.2 Questions de recherche et plan de la thèse

Cette thèse est composée de trois partie de recherche, chacune présentant deux chapitres de recherche correspondant à deux travaux distincts.

1.1.2.1 Régulation dans le secteur des télécommunications

La première partie de recherche de cette thèse adresse des problématiques liées à l'application de la régulation ex-ante dans le secteur des TIC, et plus particulièrement dans l'industrie des télécommunications. Cette partie est composée de deux chapitres, chacun abordant un sujet différent.

Dynamique d'entrée et d'investissement dans les infrastructures de nouvelle génération: Analyse empirique dans le secteur des télécommunications. Le premier chapitre de cette partie est consacré à l'évaluation empirique de l'échelle de l'investissement dans le secteur des télécommunications. L'échelle de l'investissement est une régulation appliquée par de nombreux pays européens qui vise à favoriser l'investissement progressif en infrastructure de réseaux de la part des nouveaux entrants. Or, cette régulation n'est basée sur aucun modèle théorique, et il n'existe pas à ce jour d'évaluation empirique de ses effets. Le but de ce chapitre est d'estimer l'impact de cette régulation sur les investissements des entrants. Je montre que l'échelle de l'investissement n'a aucun impact sur l'investissement en réseaux de nouvelles génération de la part des entrants, mais qu'il existe un impact positif faiblement significatif de cette régulation sur l'investissement au niveau du dégroupage de la boucle locale.

Les tests ex-ante d'effet de ciseaux tarifaires dans le secteur des télécommunications: Qu'est-ce qu'un opérateur raisonnablement efficace? Le deuxième chapitre de cette première partie de recherche est consacré à l'analyse des pratiques de régulateurs européens en terme d'évaluation ex-ante de ciseaux tarifaires. De nombreux régulateurs européens conduisent des tests d'effet de ciseaux tarifaires afin de s'assurer que leur régulation de l'accès ne produit pas d'effet anticoncurrentiel, par exemple. Or, il n'existe pas de règles claires régissant cette analyse d'effet de ciseaux tarifaires ex-ante, et il existe de nombreuses asymétries d'un pays à l'autre. Ce chapitre vise à comprendre ce que les régulateurs modélisent lorsqu'ils conduisent de tels tests, en analysant les définitions d'un "opérateur raisonnablement efficace". Je retranscris ensuite les ajustements théoriques faits au test classique ("Equally Efficient Operator") afin de modéliser des opérateurs raisonnablement efficaces.

1.1.2.2 Politique de la concurrence dans le secteur des TIC

La seconde partie de recherche de cette thèse traite de deux problèmes de politique de la concurrence ex-post dans le secteur des TIC, chacun adressé au sein d'un chapitre.

Vente liée et coûts de changement. Le premier chapitre de cette deuxième partie de recherche analyse l'impact des coûts de changement sur une stratégie de vente liée établie par une firme en position dominante sur un marché donné. Ce chapitre porte sur une question relative à certains marchés du secteur des TIC, tel que celui de la téléphonie mobile et de son interaction avec les services de paiement sur mobiles. Il explique pourquoi une firme simultanément en position dominante sur un marché donné et active sur un marché en concurrence peut avoir intérêt à pratiquer la vente liée, afin de transférer les coûts de changement des consommateurs du marché en monopole vers le marché en concurrence.

Politique de la concurrence dans le secteur du livre électronique. Dans le deuxième chapitre de recherche de cette seconde partie, j'étudie les effets de l'application de la politique de concurrence, et plus particulièrement les décisions du Department of Justice (DOJ) américain, sur le marché du livre électronique. Dans ce marché, les autorités américaines (et européennes) ont imposé un type d'organisation industrielle entre éditeurs de livres et revendeurs en ligne. Elles ont interdit les organisations industrielles de type “agency”, où les éditeurs choisissent eux-mêmes le prix de détail payé par les consommateurs. Dans ce chapitre, j'analyse les distorsions de marché liées aux deux différentes organisations, et j'explique en quelle circonstance l'une est préférable à l'autre en terme de bien-être social. J'étudie également le rôle des liseuses et appareils permettant d'accéder aux livres électroniques et de les utiliser.

1.1.2.3 L'interaction entre régulation et politique de la concurrence: le cas de l'effet de ciseaux tarifaires

La troisième partie de recherche de cette thèse s'attarde à l'analyse de problématiques résultantes de l'interaction entre régulation ex-ante et politique de la concurrence ex-post dans le secteur des télécommunications. Elle porte plus précisément sur l'analyse de l'effet de ciseaux tarifaires, lorsque la politique de la concurrence ex-post est appliquée dans des marchés régulés ex-ante.

Ciseaux tarifaires et préservation du monopole dans les industries régulées. Le premier chapitre de cette troisième partie de recherche explique comment une firme verticalement intégrée en position de monopole et régulée sur le marché amont peut entreprendre des ciseaux tarifaires via un prix de détail faible, afin de bloquer l'entrée d'un concurrent aval dans le court terme pour préserver sa position de monopole amont sur le long terme. Ce chapitre apporte ainsi une explication rationnelle à la pratique des ciseaux tarifaires dans les industries de réseaux. De plus, il explique dans le détail en quoi cette pratique diffère d'autres abus de position dominante bien connus en politique de la concurrence, et pourquoi il convient de la définir comme abus à part entière.

L'interaction entre ciseaux tarifaires et régulation de l'accès. Le dernier chapitre de recherche de cette thèse traite de la question du lien entre effet de ciseaux tarifaires et régulation de l'accès. Dans ce chapitre, j'étudie l'impact de la régulation de l'accès à un monopole naturel sur les incitations à engager une stratégie anticoncurrentielle de ciseaux tarifaires pour une firme dominante verticalement intégrée. Je montre notamment que le résultat établi de la littérature comme quoi une augmentation de la charge d'accès mène à une diminution des incitations à pratiquer des ciseaux tarifaires n'est pas robuste à une modélisation en concurrence homogène.

1.1.2.4 Plan de la thèse

La suite de cette thèse est organisée comme suit. Le reste de cette partie I est dédié à un résumé étendu en français de chaque chapitre de recherche. Le reste de la thèse est rédigé en anglais. La partie II comprend une introduction générale. la partie III contient deux chapitres de recherche et porte sur la régulation dans le secteur des télécommunications. La partie IV analyse deux problématiques liées à l'application de la politique de la concurrence dans le secteur des TIC. La partie V contient également deux chapitres de recherche, qui portent sur l'application de la politique de la concurrence ex-post dans le secteur des télécommunications, et plus particulièrement le marché des réseaux fixes, qui sont régulés ex-ante. Enfin, la partie VI de cette thèse est une conclusion générale.

1.2 Régulation dans le secteur des télécommunications

1.2.1 Dynamique d'entrée et d'investissement dans les infrastructures de nouvelle génération: Analyse empirique dans le secteur des télécommunications

1.2.1.1 Introduction

Dans les industries de réseaux, les problématiques d'investissement constituent un point crucial des relations entre les acteurs du marché (firmes, pouvoirs publics). De manière générale, les régulateurs sectoriels qui fixent le cadre du marché ex-ante font face à un arbitrage entre promouvoir la concurrence et favoriser l'investissement. Par exemple, dans le secteur des télécommunications, il y a eu un débat important relatif à la question de savoir si le développement de la concurrence par les services retardait l'introduction de la concurrence par les infrastructures, qui est souvent vu comme le but d'une régulation sectorielle. En effet, la théorie standard prédit qu'un entrant qui loue un accès au réseau de la firme en place possède un coût d'opportunité à l'investissement dans ses propres infrastructures, qu'il ne possède pas s'il ne loue pas cet accès au réseau.

L'échelle de l'investissement (Cave [2006]) est une approche réglementaire qui propose de résoudre cet arbitrage du régulateur. Cet approche postule que la concurrence par les services non seulement introduit aisément de la concurrence sur un marché donné, mais constitue également une étape pour promouvoir la concurrence par les infrastructures. L'idée de cette approche est qu'une phase de concurrence par les services permet aux entrants d'acquérir de l'expérience et une connaissance du marché qui leur permettra par la suite d'investir dans leurs infrastructures plus facilement (Bourreau and Drouard [2010] étudient l'effet d'une phase d'acquisition d'expérience sur les incitations des entrants à l'investissement).

Les régulateurs européens ont en effet basé leur régulation en se fondant sur cette approche. D'une part, des règlements européens obligent les firmes en place à louer leur réseau au niveau de la boucle locale de cuivre ("Local Loop Unbundling", LLU) aux entrants. D'autres part, de nombreux régulateurs obligent également les firmes en place à louer leur réseau à un niveau plus agrégé aux entrants (niveau d'accès "bitstream"). Enfin, certaines firmes en place développent elles-mêmes de telles offres commerciales, au niveau bitstream et à un niveau plus agrégé encore (niveau "resale"). Ces différents niveaux d'accès ne nécessitent pas tous les mêmes investissements en infrastructures de la part des entrants. Par exemple, pour louer un accès LLU, un entrant devra construire son réseau de collecte et "backbone", alors que pour un accès resale il n'aura pas besoin de telles infrastructures. En haut de cette échelle de l'investissement, un entrant peut investir dans l'intégralité d'un réseau de communications, en construisant son propre réseau d'accès; il s'affranchit ainsi de louer une partie du réseau de la firme en place. Différentes technologies permettent aux entrants d'investir dans leurs réseaux d'accès après avoir loué un accès au réseau de la firme en place: le cuivre, la fibre, la boucle locale radio ("Wireless Local Loop", WLL), ou le courant porteur en ligne ("Power Line Communication", PLC).[1]

Bien que cette approche réglementaire ait été implémentée par de nombreux régulateurs européens dans le secteur des télécommunications, elle ne bénéficie d'aucun support théorique, et il n'existe pas d'étude empirique validant ses conclusions sur l'investissement des entrants.

[1]D'autres technologies, telles que le cable ou le satellite, ne sont pas compatibles avec un accès au réseau de télécommunications de la firme en place, initialement construit pour la téléphonie fixe.

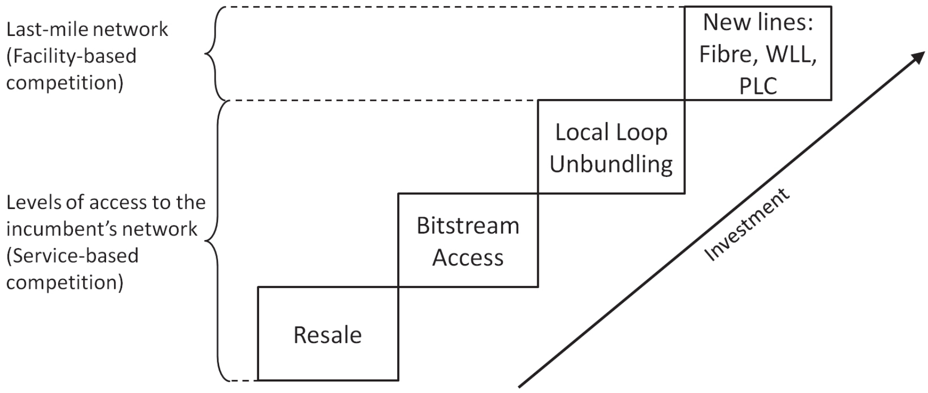


Figure 1.1: L'échelle d'investissement et les différents niveaux d'accès

La Figure 1.1 détaille les différents niveaux d'accès de l'échelle de l'investissement, telle que présentée par Cave [2006]. Plus l'entrant souhaite s'affranchir de sa dépendance au réseau de la firme en place, plus il doit investir dans ses propres infrastructures de réseaux, et plus il pourra opérer des choix techniques propres et différencier son offre.

1.2.1.2 Analyse empirique

L'analyse empirique se base sur des données publiques de la Commission Européenne, portant sur un panel de données de 15 pays (Allemagne, Autriche, Belgique, Danemark, Espagne, Finlande, France, Grèce, Irlande, Italie, Luxembourg, Pays-Bas, Portugal, Royaume-Uni, Suède) sur 17 semestres (juillet 2002-juillet 2010).

Les variables définies sont les suivantes:

- $\log(Newlines)$ correspond au nombre de lignes haut-débit appartenant aux entrants, développées via leur infrastructure propre de nouvelle technologie (fibre, WLL, PLC), en logarithme.

- $\log(LLUlines)$ correspond au nombre de lignes haut-débit louées par les entrants au niveau LLU, en logarithme.

- $\log(BAlines)$ correspond au nombre de lignes haut-débit louées par les entrants au niveau accès bitstream, en logarithme.

- *incmob* est une variable de contrôle qui représente la part de marché de la firme en place dans le marché de la téléphonie mobile. Cette variable est un proxy pour le pouvoir de marché de la firme en place.

- Les variables de contrôle pour les chocs de demande sont le PIB par tête en euros constants en logarithme, $\log(GDPpercapita)$, la population du pays en logarithme $\log(Pop)$, et le taux de pénétration de la téléphonie mobile $mobpenrate$.

- La variable de contrôle pour le coût des réseaux est la densité de la population $density$.

L'impact de l'échelle de l'investissement sur les investissements en nouvelles infrastructures des entrants est modélisé comme suit:

$$\begin{aligned}\log(Newlines)_{i,t} = \beta_0 + \beta_1 \log(Newlines)_{i,t-1} + \beta_2 \log(LLUlines)_{i,t-2} \\ + \beta_x controls_{i,t} + \varepsilon_i + \eta_t + u_{i,t}, \end{aligned} \tag{1.1}$$

où $Newlines_{i,t}$ représente le nombre (en stock) des lignes haut-débit des entrants dans le pays i au semestre t qui sont basées sur les technologies fibre, WLL, et PLC. $LLUlines_{i,t}$ correspond au nombre de lignes des entrants basées sur l'accès à la boucle locale de la firme en place (LLU), et $controls$ un set de variables de contrôle. Comme le haut-débit dépend de spécificités liées à la demande du marché ou à des facteurs institutionnels, des effets fixes par pays (ε_i) et temporels (η_t) sont introduits.

Le test empirique porte sur l'hypothèse de l'échelle de l'investissement, selon laquelle la concurrence par les services promeut l'investissement en infrastructure des entrants. Pour tester cette hypothèse, il faut évaluer l'impact de l'entrée au niveau de la concurrence en services sur l'entrée au niveau des nouvelles infrastructures. Ainsi, l'hypothèse de l'échelle de l'investissement est vérifiée si β_2 est significativement positif.

Parallèlement à cette évaluation empirique sur les plus hauts niveaux d'accès de l'échelle de l'investissement, une autre analyse est conduite, sur les niveaux d'accès inférieurs. Cette analyse sur cette "échelle réduite" (par contraste avec "l'échelle complète" énoncée ci-dessus à l'équation (1.1)) permet d'observer si l'approche de l'échelle de l'investissement est valide si l'on considère le développement de l'accès à la boucle locale (LLU) comme une finalité de la régulation.

L'échelle réduite est évaluée avec le modèle suivant:

$$\begin{aligned}\log(LLUlines)_{i,t} = \beta_0' + \beta_1' \log(LLUlines)_{i,t-1} + \beta_2' \log(BAlines)_{i,t-2} \\ + \beta_x' controls_{i,t} + \varepsilon_i + \eta_t + u_{i,t}.\end{aligned} \tag{1.2}$$

Si l'hypothèse de l'échelle de l'investissement est vérifiée pour cette échelle réduite, nous devrions observer $\beta_2' > 0$.

Les estimations empiriques sont effectuées à l'aide de la technique GMM ("Generalized Method of Moments"). Les résultats de l'estimation, indiqués en Table 1.1 montre qu'il n'y a aucun effet significatif du développement de la concurrence au niveau de la boucle locale (LLU) sur l'investissement des entrants en infrastructures de nouvelle génération ($Newlines$). Par contre, via l'analyse sur l'échelle réduite, nous observons un effet positif et (faiblement) significatif de $BAlines$ sur $LLUlines$. Ceci implique un effet de l'échelle de l'investissement jusqu'au niveau de la boucle locale.

1.2.1.3 Discussion

Ces résultats ont été répliqués suivant différentes méthodes d'estimation (OLS, IV) et différents modèles (en flux de lignes), et des tests de robustesses ont été conduits. Plus précisément, nous avons, pour ces tests de robustesse, pris en compte le nombre de niveaux d'accès à l'échelle, le développement du cable haut-débit, l'intensité de la régulation, et les prix de la boucle locale. Le résultat principal, sur l'échelle complète, reste inchangé pour tous ces tests de robustesse. A contrario, le résultat positif sur l'échelle réduite ne passe que certains tests, ce qui nous pousse à définir ce résultat d'un effet échelle de l'investissement positif sur l'échelle réduite comme "faible" (faiblement robuste).

En conclusion, ce chapitre montre que l'échelle de l'investissement, une approche réglementaire, sans base théorique ni empirique, largement employée par les régulateurs européens, semble inefficace car elle ne remplit pas son objectif premier qui est l'investissement des entrants dans leurs propres infrastructures d'accès local. Cette approche de régulation semble toutefois avoir un effet positif pour l'investissement jusqu'au niveau de la boucle locale (LLU), mais ce résultat

	Echelle complète	Echelle réduite
	GMM-Diff	GMM-Diff
	$\log(Newlines)_t$	$\log(LLUlines)_t$
$\log(Newlines)_{t-1}$	0.552***	
	(3.78)	
$\log(LLUlines)_{t-1}$		0.613***
		(4.80)
$\log(LLUlines)_{t-2}$	-0.0931	
	(-0.91)	
$\log(BAlines)_{t-2}$		0.0515*
		(2.10)
$incmob_t$	-0.489	1.453
	(-0.26)	(1.03)
$\log(GDPpercapita)_t$	-1.802	0.220
	(-0.76)	(0.38)
$mobpenrate_t$	-0.00549	0.0126
	(-0.31)	(1.72)
$density_t$	0.0484	0.0602
	(0.63)	(1.46)
$\log(Pop)_t$	8.817	-4.637
	(0.60)	(-0.58)
N	171	207
$Arellano-Bond\ test\ AR(1)$	-2.08	-2.12
$(p-value)$	(0.038)	(0.034)
$Arellano-Bond\ test\ AR(2)$	-0.30	-1.17
$(p-value)$	(0.761)	(0.242)
$Hansen\ J-test\ (p-value)$	(1.000)	(1.000)
$F-test\ (time)$	3.90	
$(p-value)$	(0.0089)	

Notes: t-statistiques entre parenthèses. Niveaux de significativité: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Variables instrumentées: $\log(LLUlines)_{t-2}$, Instruments: $\log(BAlines)_{t-4}$.
Effets fixes temps inclus dans la régression sur l'échelle complète.

Table 1.1: Résultats principaux

n'est pas entièrement robuste.

1.2.2 Les tests ex-ante d'effet de ciseaux tarifaires dans le secteur des télécommunications: Qu'est-ce qu'un opérateur raisonnablement efficace?

1.2.2.1 Introduction

Dans le secteur des télécommunications, de nombreux cas antitrust récents ont été basés sur l'analyse d'effets de ciseaux tarifaires. Cette pratique consiste pour une firme en place verticalement intégrée à fixer des prix de gros et de détail tels que la marge dont disposent les entrants sur le marché aval ne leur permet pas d'opérer profitablement sur le marché.

Alors que les autorités de concurrence basent leur analyse des tests de ciseaux tarifaires sur le droit de la concurrence et la jurisprudence, les régulateurs conduisent également des tests de ciseaux tarifaires afin de s'assurer, par exemple, que les prix de gros régulés ne produisent pas un tel effet; et ce, souvent sans se baser sur des lignes directrices précises. Aussi, les pratiques des régulateurs du secteur des télécommunications en matière de test d'effet de ciseaux tarifaires divergent. Ce chapitre porte sur l'analyse de tels tests, et sur les ajustements théoriques possibles pour que les régulateurs modélisent un "opérateur raisonnablement efficace".

En effet, alors que la droit de la concurrence européen définit clairement qu'un opérateur "aussi efficace" constitue la base à adopter pour conduire un test de ciseaux tarifaires ex-post, les régulateurs ex-ante ne possèdent pas cette base et ajustent le test de l'opérateur aussi efficace pour le transformer en un test d'opérateur raisonnablement efficace.

1.2.2.2 Ajustements théoriques

En droit de la concurrence européen, un test de ciseaux tarifaire est défini par le test EEO ("Equally Efficient Operator"), qui compare le prix de détail fixé par la firme en place (p) à la somme de la charge d'accès (régulée ou non) aux infrastructures essentielles de la firme en place (a), et le coût aval de cette même firme (c). Une firme en place n'induit donc pas d'effet de ciseaux tarifaires lorsque:

$$p \geq a + c. \tag{1.3}$$

Ainsi, ce test permet le développement dans l'environnement concurrentiel d'entrants au moins aussi efficace que la firme en place verticalement intégrée.

Cependant, les régulateurs qui interviennent ex-ante ont pour but de façonner le cadre concurrentiel, non pas de faire respecter les règles du jeu concurrentiel comme le font les autorités de concurrence. Aussi, ces régulateurs peuvent parfois ajuster le test EEO pour établir un test REO ("Reasonably Efficient Operator") qui permet aux entrants de surpasser les désavantages concurrentiels induits par les asymétries entre eux et la firme en place.

Trois ajustements possibles concernent le coût de la firme en place utilisé dans le test EEO. Le premier de ces trois ajustements prend en compte les économies d'échelle de la firme en place, qui bénéficie généralement d'une plus grande base de consommateurs et donc de plus grandes économies d'échelle. Ainsi, le régulateur peut fixer une base de demande théorique $\widetilde{D}$ à laquelle sera évaluée le coût aval de la firme en place:

$$p \geq a + c(\widetilde{D}). \tag{1.4}$$

Le deuxième ajustement de coût tient compte des économies d'envergure de la firme en place. Cet ajustement permet au régulateur de fixer un paramètre, α, pour tenir compte de tout, partie, ou non, de l'avantage concurrentiel induit par les économies d'envergure de la firme en place. Celle-ci peut en effet produire différent produits (aux quantités q_1 et q_2) et attribuer ses coûts fixes F à l'une, l'autre, ou les deux productions, lorsque l'entrant ne le peut pas:

$$p \geq a + c + \alpha \frac{F}{q_1}. \tag{1.5}$$

Le dernier ajustement possible à tenir des asymétries de coût entre firme en place et entrants considère simplement les coûts spécifiques aux entrants, c_s, dans le test de ciseaux tarifaires:

$$p \geq a + c + c_S. \tag{1.6}$$

Par ailleurs, un ajustement possible peut être effectué sur le paramètre de la charge d'accès dans le test de ciseaux tarifaires. En effet, lorsque plusieurs produits de gros (régulés ou non) sont disponibles, le régulateur peut conduire un test pour chaque type d'accès de gros, ou alors ne conduire qu'un seul test en prenant en compte un mix (moyenne pondérée) de ces produits de gros. Le test avec ce mix s'écrit ainsi:

$$p \geq \sum_{i=1}^{n} \gamma_i (c_i + a_i), \tag{1.7}$$

où $\gamma = (\gamma_1, ..., \gamma_n)$ pondère les coûts et charges d'accès, avec $\sum_{i=1}^{n} \gamma_i = 1$ et $\gamma_i \geq 0, \forall i = \{1, ..., n\}$, et c_i correspond au coût aval de la firme en place associé au produit de gros avec la charge d'accès a_i.

Enfin, le dernier ajustement possible pour les régulateurs afin de modifier un test EEO en test REO porte sur le paramètre prix du test. En effet, un test REO peut prendre en compte le fait que la firme en place pratique la vente liée entre les produits 1 et 2 aux prix individuels p_1 et p_2, et vend le bundle au prix $\overline{p}$, alors que l'entrant ne peut répliquer cette offre s'il ne peut vendre que le produit 1. Ainsi, le régulateur peut considérer un pourcentage de la marge effectuée sur le bundle dans le test de ciseaux tarifaires, basé sur le prix du produit non-reproductible par l'entrant (p_2). Le test REO est ainsi:

$$\overline{p} - p_2 + \beta(p_2 - c_2) \geq a + c_1. \tag{1.8}$$

En résumé, plusieurs ajustements sont théoriquement possibles pour passer d'un test EEO à un test REO ex-ante. Ils sont listés dans la Table 1.2. Il convient

Paramètre	**Problème spécifique**
Coûts	Economies d'échelle Economies d'envergure Coûts spécifiques des entrants
Charge d'accès	Mix d'accès
Prix	Vente liée

Table 1.2: Problèmes spécifiques dans les tests ex-ante d'effet de ciseaux tarifaires

de noter que ces ajustements ne sont pas automatiques et que les régulateurs doivent arbitrer entre désavantage à court terme dû aux pertes d'efficacité liées aux ajustements du test EEO et avantage à long terme dû à l'introduction d'une concurrence pérenne et l'efficacité apportée par les entrants.

1.2.2.3 Comparaison des pratiques des régulateurs

Après avoir défini les ajustements théoriques possibles pour que les régulateurs modélisent un test REO, nous analysons les pratiques de certains régulateurs européens, afin de donner des exemples concrets à ces ajustements au test EEO. Les décisions et lignes directrices étudiées dans cette analyse comparative sont listées dans la Table 1.3.

Les ajustements effectués sur le paramètre de coût du test de ciseaux tarifaires sont reproduits dans la Table 1.4. Les ajustements effectués sur le paramètre de la charge d'accès du test de ciseaux tarifaires sont reproduits dans la Table 1.5. Enfin, les ajustements effectués sur le paramètre de prix du test de ciseaux tarifaires sont reproduits dans la Table 1.6.

1.2.2.4 Discussion

Les régulateurs ajustent donc, pour beaucoup, leurs tests afin de modéliser des REO. Alors que certains ajustements, tel que celui tenant compte des économies d'échelle, font relativement consensus, d'autres ont des applications bien différentes. De plus, certains ajustements répandus posent de forts problèmes. Ainsi, le mix de produit d'accès est un ajustement répandu, mais il induit automatiquement un problème d'endogénéité dans la régulation en place lorsqu'il est déterminé sur le mix actuel du marché, et non sur le mix souhaité par le régulateur qui maximiserait sa fonction d'objectif.

Ce chapitre de recherche montre que des travaux théoriques et empiriques sont nécessaires à la bonne utilisation des tests de ciseaux tarifaires par les autorités de régulation ex-ante. Le caractère même de leur utilisation par ces autorités peut être questionné.

Marché Géographique	**Autorité**	**Année**	**Document**	**Marché**
Europe	EC (Commission Européenne)	2010	European Recommendation 2010/572/EU on regulated access to NGAN	*Lignes directrices*
Europe	ERG (European Regulators Group)	2003	ERG Common Position on the approach to Appropriate remedies in the new regulatory framework	*Lignes directrices*
		2009	Report on the Discussion on the application of margin squeeze tests to bundles	*Rapport*
Austriche	RTR	2008	RTR Communications Report 2008	*Guidelines*
		2010	Margin Squeeze Überprüfungen in der sektorspezifischen ex ante-Regulierung für Telekommunikationsmärkte Kritische Punkte und neue Herausforderungen	*Lignes directrices*
Belgique	BIPT	2007	Décision établissant des lignes directrices relatives à l'évaluation des effets de ciseaux tarifaires	*Lignes directrices*
		2009	Décision concernant le test de ciseaux tarifaires des lignes louées Ethernet	Lignes louées
France	ARCEP	2006	Notice du test d'effet de ciseaux tarifaires téléphonie fixe	Téléphonie fixe
Allemagne	BNetzA	2007	Notes on margin squeezes as defined by section 28(2) para 2 TKG	*Lignes directrices*
Irlande	ComReg	2011	Response to Consultation Document No. 10/76 and decisions amending price control obligations and withdrawing and further specifying transparency obligations	Terminaison d'appel
		2012	Further specification to the price control obligation and an amendment to the transparency obligation, D06/12	Accès de gros broadband
Italie	AGCOM	2010	Delibera 499/10/CONS and Appendix	*Lignes directrices (Réseaux fixes)*
Pays-Bas	OPTA	2001	OPTA and NMa Price Squeeze Guidelines (OPTA/EGM/2000/200494, NMa /2201/12)	*Lignes directrices (Réseaux fixes)*
Pologne	UKE	2009	UKE and TPSA Agreement concluded on 22 October 2009, and Annex 9	Accès de gros broadband
Portugal	Anacom	2007	Determination on the method to assess margin squeezes in Broadband offers provided by the PT Group	Accès de gros broadband
Espagne	CMT	2007	Resolución MTZ 2006/1486	*Lignes directrices*
		2008a	Resolución AEM 2008/215	*Lignes directrices*
		2008b	Voto Particular de Marcel Coderch e Inmaculada López en su condición de Consejeros de la CMT en relación a la Resolución AEM 2008/215	
Grande-Bretagne	Ofcom	2004	Direction Setting the Margin between IPStream and ATM interconnection Prices (BT IPStream)	Internet Broadband
Etats-Unis	FCC	2005	In the Matter of Unbundled Access to Network Elements; Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (FCC 04–290)	*Lignes directrices*

Table 1.3: Décisions et Lignes directrices analysées

Référence	**Economies d'échelle**	**Economies d'envergure**	**Coûts spécifiques des entrants**
Commission Européenne [2010]	Oui.	Oui.	
European Regulators Group [2003]	Part de marché de la firme en place réduite à 20-25%.	Une approche est de calculer les coûts de la firme en place en annulant ses économies d'envergure ($\alpha = 1$).	
Autriche (RTR, 2010)	Pas pour les marchés non-NGAN.	Utilisation des coûts évitables (test mono-produit) et LRAIC (test combinatoire).	
Belgique (BIPT, 2007)	Part de marché de la firme en place réduite à 25%.	Utilisation des LRIC (ou FAC) et tests combinatoires.	Oui.
Belgique (BIPT, 2009)	Part de marché de la firme en place réduite à 20-25%.		
France (ARCEP, 2006)			Oui (modèle bottom-up).
Allemagne (BNetzA, 2007)	Non (analyse de long terme).	Non (analyse de long terme).	Non (analyse de long terme).
Irlande (ComReg, 2011)		Utilisation de LRAIC+.	
Irlande (ComReg, 2012)	Part de marché de la firme en place réduite à 25% (pour le second test). Demande de la firme en place réduite à une moyenne pondérée (51k, 88k et 91k lignes LLU).		
Pays-Bas (OPTA, 2001)	Non (test EEO).	Non (test EEO).	
Portugal (Anacom, 2007)	Non.		
Grande-Bretagne (Ofcom, 2004)	Demande de la firme en place réduite à 1,7 - 2,5 millions de consommateurs (période de 5 ans).	Utilisation des FAC.	

Table 1.4: Ajustements des coûts dans les tests de ciseaux tarifaires

Référence	**Mix d'accès**
France (ARCEP, 2006)	Oui: local exchange 80%, tandem exchange 20% (modèle bottom-up).
Irlande (ComReg, 2011)	Oui: moyenne pondérée pour l'interconnexion au niveaux local, single tandem, et double tandem (respectivement 66%, 24%, et 10%).
Italie (AGCOM, 2010)	Oui: moyenne basée sur données nationales et mises à jour fréquemment.
Espagne (CMT, 2007)	Oui.
Espagne (CMT, 2008a)	Oui: moyenne basée sur données nationales et mises à jour tous les 6 mois (LLU 73.8%, GigADSL 8.7%, ADSL-IP 17.5%).

Table 1.5: Ajustements des charges d'accès dans les tests de ciseaux tarifaires

Référence	**Vente liée**
Austriche (RTR, 2010)	Un test agrégé.
Allemagne (BNetzA, 2007)	Traitement au cas-par-cas.
Italie (AGCOM, 2010)	Un test agrégé.
Pologne (UKE, 2009)	Test par produit, prix implicite net des coûts incrémentaux ($\beta = 1$).
Espagne (CMT, 2007)	Pas directement pris en compte dans les tests: test de réplicabilité additionnel.

Table 1.6: Ajustements des prix dans les tests de ciseaux tarifaires

1.3 Politique de la concurrence dans le secteur des TIC

1.3.1 Vente liée et coûts de changement

1.3.1.1 Introduction

Dans certains marchés de télécommunications mobiles, les opérateurs ont développé des services de paiement sur mobile très profitables. Par exemple, au Kenya, l'opérateur de télécommunications Safaricom est devenu un leader du marché bancaire en introduisant son service de paiement sur mobile. Dans ce pays, le marché des télécoms est très concurrentiel, mais le marché du paiement sur mobile reste monopolistique, dû à d'important coûts fixes (développement du réseau d'agence). De plus, les consommateurs restent fidèles à un opérateur de services de paiement sur mobile, car il est coûteux et pénible de résilier son contrat.

D'autres exemples de firmes en position dominante sur un marché avec des coûts de changement importants pour les consommateurs, et en concurrence sur un marché distinct, peuvent être tirés de l'industrie bancaire. Ce chapitre de thèse analyse la stratégie tarifaire d'un opérateur qui est simultanément en position de monopole sur un marché sur lequel les consommateurs subissent des coûts à résilier leur contrat, et en concurrence sur un second marché. Je montre qu'une entreprise dans cette configuration peut avoir intérêt à pratiquer la vente liée afin de transférer les coûts de changement auxquels font face les consommateurs du marché en monopole vers le marché concurrentiel.

1.3.1.2 Modèle

Dans le modèle, basé sur Choi [2004] et Klemperer [1987], la firme 1 est active sur deux marchés: l'un en monopole (le marché A), et l'autre en concurrence (marché B), sur lequel est active la firme 2. Sur le marché B les deux firmes se font concurrence à la Hotelling. Les consommateurs ont une valorisation de V pour le bien du marché A, et de r pour le bien du marché B. Je suppose que r est grand donc le marché B est couvert. Les consommateurs ont un coût de transport t par unité de transport sur le marché B et sont localisés de façon homogène. De plus, si un consommateur décide de ne plus acheter le bien du marché A, il lui en coûte s en frais administratifs (s n'est récupéré par aucune firme). Le jeu comporte deux périodes, et le facteur d'escompte est égal à 1.

Lorsque la firme 1 ne pratique pas la vente liée, il est facile de prouver que les profits des firmes sur les deux périodes sont:

$$\begin{cases} \Pi_1 = \pi_1^{t1} + \pi_1^{t2} = t^2 + 2tV, \\ \Pi_2 = \pi_2^{t1} + \pi_2^{t2} = t^2. \end{cases} \tag{1.9}$$

De plus, lorsque la firme 1 pratique la vente liée est que $s = 0$, il est facile de montrer que les profits sont:

$$\begin{cases} \bar{\Pi}_1 = \bar{\pi}_1^{t1} + \bar{\pi}_1^{t2} = t^2 + \frac{2tV}{3} + \frac{V^2}{9}, \\ \bar{\Pi}_2 = \bar{\pi}_2^{t1} + \bar{\pi}_2^{t2} = t^2 - \frac{2tV}{3} + \frac{V^2}{9}. \end{cases} \tag{1.10}$$

J'analyse les incitations pour la firme 1 à pratiquer la vente liée. Pour ce faire, je pose certaines hypothèses de simplification (tous les consommateurs ont des préférence, c-à-d leur localisation sur la ligne d'Hotelling, indépendantes d'une période à l'autre) et des hypothèses pour que la vente liée ne soit pas profitable à la firme 1 per se ($V < 3t$, voir équations (1.9) et (1.10)).

1.3.1.3 Analyse et résultats

D'après le modèle, les profits de firmes dans la seconde période du jeu lorsque la firme 1 pratique la vent liée sont:

$$\begin{cases} \bar{\pi}_1^{t2} = \frac{1}{18}(3t + V + s\sigma)^2, \\ \bar{\pi}_2^{t2} = \frac{1}{18}(3t - V - s\sigma)^2. \end{cases} \tag{1.11}$$

Il est ensuite possible de montrer que les prix et quantités à l'équilibre dans la première période sont

$$\begin{cases} \bar{P}^{t1*} = c + t + \frac{V}{3} + \frac{s}{6}[\frac{s}{t} - 3 + \frac{s^2+3st-2sV+6tV}{7s^2+54t^2}], \\ \bar{p}_2^{t1*} = c + t - \frac{V}{3} + \frac{s}{6}[\frac{s}{t} - 1 - \frac{s^2+3st-2sV+6tV}{7s^2+54t^2}], \end{cases} \tag{1.12}$$

et

$$\begin{cases} \bar{q}_1^{t1*} = \frac{3t}{4} + \frac{t[V(7s+18t)-9t(s+3t)]}{2(7s^2+54t^2)}, \\ \bar{q}_2^{t1*} = \frac{t}{4} - \frac{t[V(7s+18t)-9t(s+3t)]}{2(7s^2+54t^2)}. \end{cases} \tag{1.13}$$

Et l'on peut en déduire le profit total de la firme 1 lorsqu'elle pratique la vente liée:

$$\begin{aligned} \bar{\Pi}_1 = \quad & t^2 + \frac{2tV}{3} + \frac{V^2}{9} + s(\frac{5s}{32} - \frac{t}{6} + \frac{5V}{24}) \\ & + \frac{s}{7s^2+54t^2}(\frac{stV}{6} - \frac{17s^2t}{24} - \frac{7st^2}{16} - \frac{29t^2V}{4} + \frac{7sV^2}{72} + \frac{5tV^2}{2}) \\ & - \frac{st^2}{(7s^2+54t^2)^2}(\frac{s^3}{16} - \frac{9s^2t}{4} + \frac{13s^2V}{4} + \frac{sV^2}{4} + 9tV^2). \end{aligned} \tag{1.14}$$

En comparant ce profit avec celui réalisé si elle ne pratique pas la vente liée pour différentes valeurs de V et de s, on obtient la Figure 1.2.

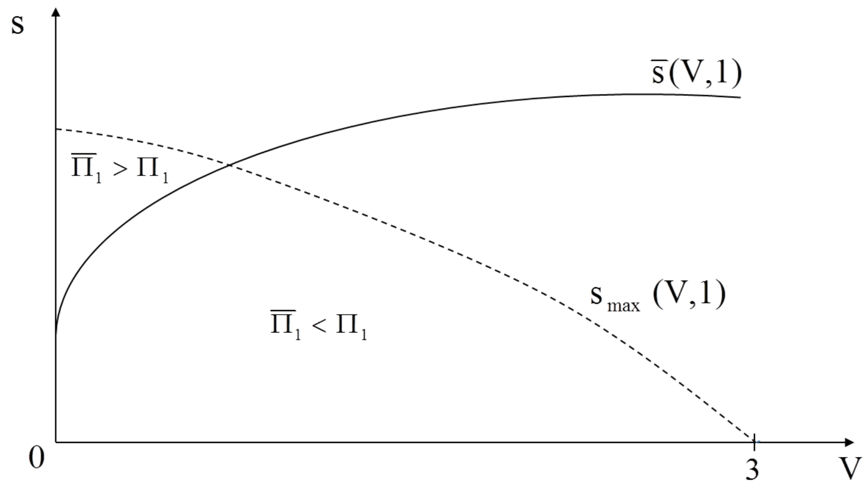


Figure 1.2: Incitation pour la Firme 1 à pratiquer la vente liée quand $t = 1$

la Figure 1.2 indique que la vente liée est profitable à la firme 1 pour des coûts de changement s relativement élevés et des valorisations du bien en monopole V relativement basses.

L'intuition du résultat est la suivante. Premièrement, une valorisation V élevée entraîne une perte de profit importante sur le marché en monopole, où l'output est réduit avec la vente liée. Deuxièmement, un coût de changement élevé permet à la firme pratiquant la vente liée d'extraire un surplus important de ses consommateurs captifs dans la seconde période. Cet arbitrage donne le résultat énoncé ci-dessus.

1.3.1.4 Discussion

Ce chapitre de thèse introduit une nouvelle explication rationnelle à la pratique de la vente liée: la vente liée peut être profitablement utilisée afin de transférer des coûts de changement des consommateurs d'un marché en monopole vers un marché concurrentiel. Lorsque la valorisation des consommateurs (ou plutôt la marge effectuée par la firme) sur le marché en monopole est faible et que les coûts de changement sont élevés, il peut être profitable de pratiquer la vente liée. Par ailleurs, la vente liée décroît le bien-être social dans ce cadre, puisqu'elle constitue un écart par rapport au "first-best".

1.3.2 Politique de la concurrence dans le secteur du livre électronique

1.3.2.1 Introduction

A la suite de l'introduction de la liseuse Kindle par Amazon en 2007, le marché du livre électronique a connu une progression rapide, en atteignant 4 milliard de dollars US en 2011. Dans cette période, le prix des livres électroniques ont connu une évolution intéressante. En effet, peu après l'entrée d'Apple en tant que revendeur avec sa liseuse iPad sur le marché en 2010, les prix des livres électroniques ont augmenté. Ceci a attiré l'attention des autorités de concurrence en Europe et aux Etats-Unis.

Alors qu'Amazon utilisait un contrat de gros classique avec les éditeurs de livres, dans lequel il était stipulé qu'il achetait les livres à un prix de gros et qu'il les revendait au prix qu'il souhaitait, Apple a introduit un nouveau type de contrat en entrant sur le marché. Ce nouveau contrat, appelé "agency", laisse les éditeurs de livres fixer le prix final payé par les consommateurs. Apple, en contrepartie, conserve un pourcentage des *revenus* provenant de la vente. Après l'introduction de ce type de contrat, les éditeurs ont fait pression, avec succès, sur Amazon afin qu'il adopte un contrat similaire.

Dans ce chapitre de thèse, j'étudie les deux types d'organisation contractuelle ("de gros", ou "agency") et leurs effets sur les prix des détails. De plus, j'analyse l'impact de la vente des liseuses, biens d'accès nécessaires pour consommer des livres électroniques, sur le prix de détail.

1.3.2.2 Modèle sans liseuse

Un éditeur en monopole vend ses produits à un distributeur en monopole, qui lui vend aux consommateurs finaux. La demande pour le produit final, $D(\cdot)$,est doublement différentiable et décroît avec le prix p. $p(\cdot)$ est la fonction de demande inverse. L'éditeur fait face à un coût marginal constant $c > 0$ de production, qui correspond par exemple aux royalties qu'il doit reverser à l'auteur du livre. $MR(q)$ représente le revenu marginal.

Contrat de gros. Avec le contrat de gros, l'éditeur choisit en premier un prix de gros w auquel il vend ses livres au distributeur. Ensuite, ce dernier fixe le prix

p_w payé par les consommateurs.

Contrat agency. Avec le contrat agency, le distributeur annonce en premier la part des revenus de l'éditeur qu'il conservera, $\alpha \in [0,1]$. Dans un second temps, l'éditeur fixe le prix de détail du livre électronique, p_a.

Pour analyser l'équilibre du contrat de gros, il suffit de prendre la "courbe de revenu marginal de la courbe de revenu marginal", $MMR(q) \equiv MR(q) + qMR'(q)$. L'équilibre est simplement obtenu à l'intersection de cette courbe et de la courbe de coût marginal, comme dans la Figure 1.3. Dans ce cas, on fait face au problème classique de double-marginalisation.

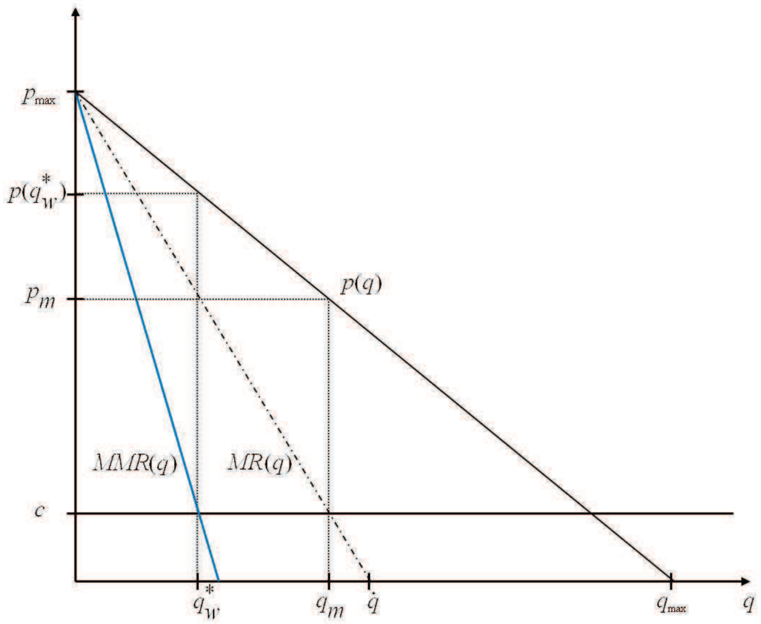


Figure 1.3: Equilibre avec le contrat de gros

Pour analyser l'équilibre du contrat agency, il faut d'abord remarquer que chaque α candidat induit une rotation vers le bas des courbes $p(q)$ et $MR(q)$. Les intersections entre $(1-\alpha)MR(q)$ et c, pour différents α, comme dans la partie en bas à gauche de la Figure 1.4, définissent la courbe $ISC(q) \equiv (1-\alpha(q))p(q)$ (*Input Supply Curve*). Ensuite, il suffit de prendre la courbe "Marginal Input Supply Curve", $(MISC(q) \equiv ISC(q) + qISC'(q))$ et son intersection avec la courbe de revenu marginal afin de déterminer l'équilibre, comme indiqué dans la Figure 1.4.

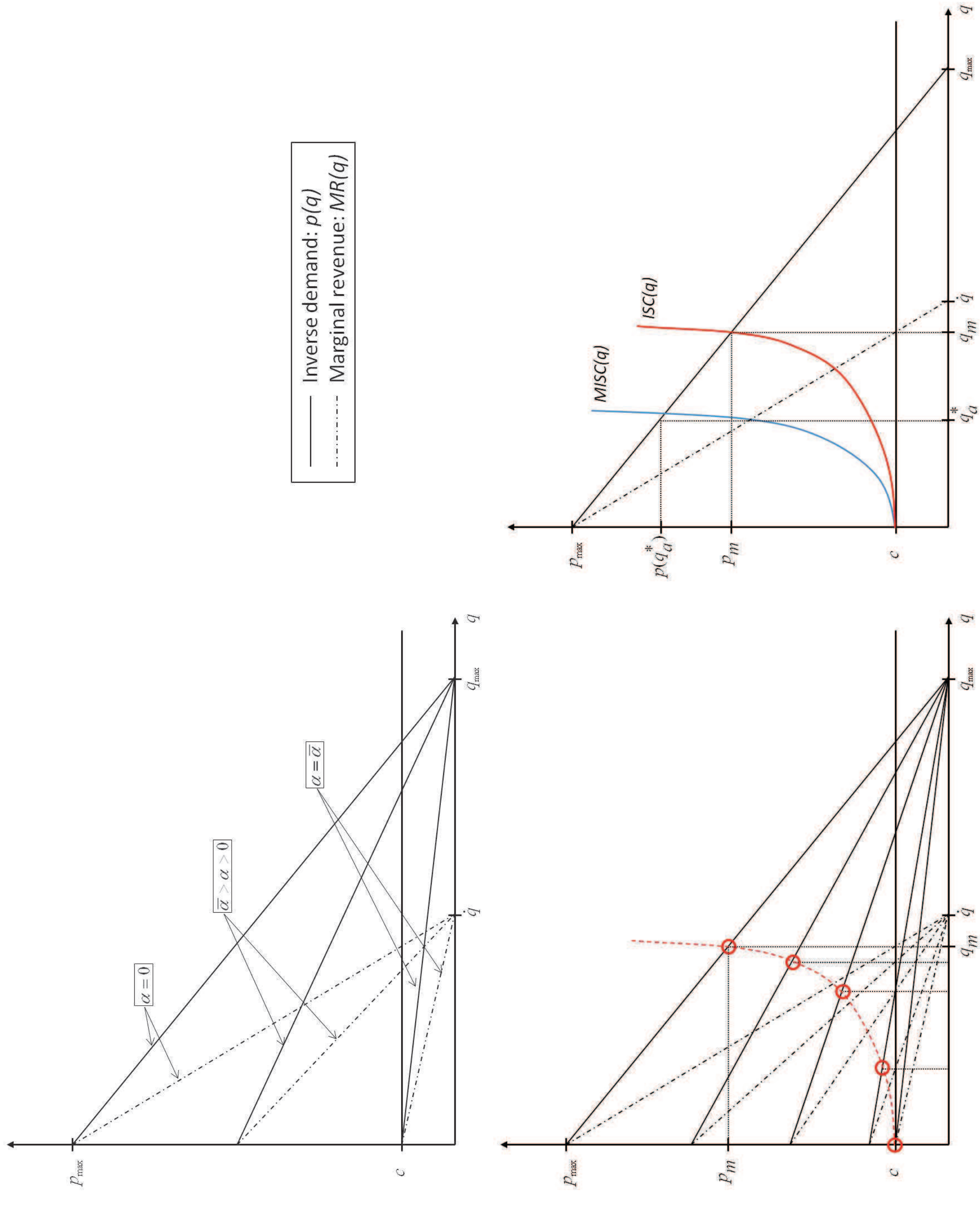


Figure 1.4: Equilibre avec le contrat agency

Ce qu'on peut déduire de cette analyse graphique, et qui est confirmé par une analyse théorique, est que, de manière générale, le prix de détail à l'équilibre avec un contrat agency est plus faible que le prix de détail à l'équilibre avec un contrat de gros. En effet, la distorsion de double-marginalisation avec le contrat de gros est généralement plus importante que celle due au fait que l'éditeur subisse l'intégralité des coûts et ne conserve qu'une proportion des profits avec le contrat agency. L'inverse est cependant vrai dans certains cas, par exemple lorsque la convexité de la fonction de demande inverse est élevée, et que le coût marginal n'est pas trop faible. Enfin, une fonction de demande à élasticité constante induira des prix de détail égaux avec les deux types de contrat.

1.3.2.3 Modèle avec liseuses

Une des caractéristiques du marché du livre électronique est que les distributeurs de livres, tels que Amazon ou Apple, sont également les principaux vendeurs de liseuses ou tablettes, ces produits permettant spécifiquement l'utilisation (l'achat et la lecture) d'un livre électronique. Ces produits agissent donc comme des biens d'accès pour l'achat des livres électroniques. Enfin, les consommateurs ont également un valorisation positive pour ce bien d'accès seul, puisqu'il permet d'aller sur internet, ou d'utiliser des livres électroniques gratuits du domaine public par exemple.

Par conséquent, si on intègre ces biens d'accès dans l'analyse, on remarque qu'avec les contrats de gros le distributeur fixe en fait un tarif binôme, où la part fixe correspond au prix de la liseuse et la part variable au prix d'un livre électronique. Si on compare les prix d'équilibre pour des w et α exogènes dans les deux types de contrat, on observe qu'une augmentation du prix du livre électronique, comme celle observée par les autorités antitrust américaines, est généralement concordante à une diminution du prix des liseuses, comme indiqué sur la Figure 1.5.

Ainsi, l'effet d'imposer un type de contrat sur le bien-être social ou le surplus des consommateurs ne peut se mesurer en observant simplement le prix des livres électroniques, et une analyse du marché des liseuses devrait être menée par les autorités antitrust en charge.

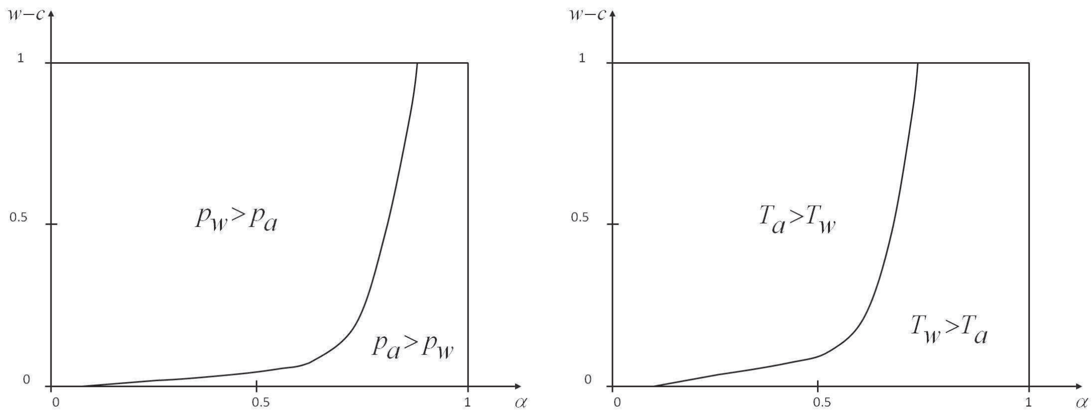


Figure 1.5: Comparaison des prix des ebooks (gauche) et des liseuses (droite) dans les contrats de gros et agency ($c = 0.07$, and $K = 0.2$)

1.3.2.4 Discussion

Ce chapitre analyse donc un marché récent sujet à un important cas antitrust. Il montre que l'augmentation de prix du livre électronique après le changement de business model de contrat de gros à contrat agency peut simplement être expliqué par les caractéristiques de la fonction de demande. De plus, l'effet global de ce changement de contrat en terme de bien-être social ou de surplus des consommateurs devrait être analysé en prenant en compte le marché des liseuses, en plus de celui du livre électronique.

1.4 L'interaction entre régulation et politique de la concurrence: le cas de l'effet de ciseaux tarifaires

1.4.1 Ciseaux tarifaires et préservation du monopole dans les industries régulées

1.4.1.1 Introduction

La politique de la concurrence concernant la pratique des effets de ciseaux tarifaires a connu de nombreuses évolutions ces dernières années. En effet, plusieurs cas antitrust, très médiatisés, liés à cette pratique, ont eu lieu aux Etats-Unis et en Europe depuis le début des années 2000. Ainsi, en Europe, les autorités de concurrence internationale ont condamné les opérateurs de télécommunications Deutsche Telekom (en 2003) et Telefonica (en 2007) à de lourdes amendes pour pratique de ciseaux tarifaires. Ces condamnations ont par la suite été confirmées par différentes cours de justice européennes. A contrario, aux Etats-Unis, la Cour Suprême a rejeté la plainte contre un opérateur de télécommunications pour ciseaux tarifaires, en expliquant que cette pratique n'était pas considérée comme anticoncurrentielle dans le droit américain, lorsqu'il n'y a ni prédation, ni refus de transaction ayant amené un obligation de transaction.

Les différences prononcées entre les façons de traiter les pratiques de ciseaux tarifaires des deux côtés de l'Atlantique trouvent leurs sources dans le fait que ces pratiques sont encore mal comprises au sens économique. Par exemple, il n'est pas clair pourquoi une firme verticalement intégrée et régulée sur son marché amont pourrait pratiquer le squeeze pour évincer un concurrent aval plus efficace qu'elle.

Dans ce chapitre, j'explique pourquoi une firme dont la charge d'accès à la ressource amont est régulée peut avoir intérêt à fixer un prix de détail bas afin d'évincer un concurrent du marché. La logique est celle du levier défensif (voir Carlton and Waldman [2002]), qui consiste à évincer un concurrent aval qui pourrait, à terme, pénétrer le marché amont et ainsi menacer le monopole de la firme en place sur ce marché.

1.4.1.2 Modèle

La firme en place I est verticalement intégrée, et possède des coûts marginaux aval c_I et amont u_I. Un entrant potentiel E possède des coûts marginaux aval $c_E < c_I$ et amont $u_E < u_I$, mais doit, pour pénétrer ces marchés, payer des coûts fixes. Ces coûts fixes sont f sur le marché aval et F sur le marché amont. S'il ne rentre que sur le marché aval, E doit acheter le produit amont à I. Les deux firmes se font concurrence en prix, et leurs produits sont homogènes.

Une autorité indépendante régule le marché amont, et fixe la charge d'accès a au produit amont de I pour tout le jeu, avec $a > u_I$. Les consommateurs sont représentés via un fonction de demande $D(p)$.

Le timing est le suivant. Dans la première période, les firmes fixent leurs prix, puis E décide de rentrer sur le marché aval ou non, avant que les consommateurs ne fassent leur choix. Dans la seconde période, les firmes fixent leurs prix, puis E décide (i) de rentrer ou non sur le marché amont s'il était rentré sur le marché aval, ou (ii) de rentrer sur les deux marchés ou sur le marché aval seulement s'il n'était pas rentré. Enfin, les consommateurs font leur choix.

1.4.1.3 Analyse et résultats

L'analyse du modèle se fait à rebours. Dans la seconde période, on voit que, s'il est entré sur le marché aval dans la première période, E investira sur le marché amont si et seulement si $F \leq (u_I + c_I - (u_E + c_E))D(u_I + c_I)$. De plus, s'il n'est pas entré sur le marché dans la première période, E restera en dehors de tous les marchés si son profit attendu $\pi_E^{VI}(.)$ évalué au prix $u_I + c_I$ est tel que $\pi_E^{VI}(u_I + c_I) - F - f < 0$.

Dans la première période, il est possible de déterminer que, pour certains paramètres, soit E entre sur le marché aval (et investira sur le marché amont dans la deuxième période), soit E n'entre pas sur le marché aval (et restera en dehors de tous les marchés dans la deuxième période). Le choix entre ces deux équilibres de sous-jeu est déterminé par le prix fixé par I dans la première période.

Ainsi, il est possible, si certaines conditions sont vérifiées, que I fixe un prix *squeezant*, c-à-d tel que $p_I < a + c_I$, dans la première période, afin de s'assurer une position de monopole (amont et aval) dans la deuxième période.

1.4.1.4 Discussion

Dans ce chapitre, j'ai expliqué comment la pratique de ciseaux tarifaires pouvait émerger d'une stratégie rationnelle dans un marché régulé. La logique économique de l'abus est proche de celle de la prédation: fixer un prix de détail faible afin d'évincer ou de bloquer un concurrent. Mais les relations verticales entre les firmes posent la question du caractère rationnel de ce type de comportement. Ici, je montre que ce type d'abus émerge si la firme en place souhaite se défendre face à une menace, sur le long-terme, d'entrée sur le marché amont monopolisé et régulé. Cette explication rationnelle qui donne naissance à un effet de ciseaux tarifaires dans un marché régulé peut également donner naissance à un refus de transaction dans un marché non-régulé (voir Chen [2013]).

1.4.2 L'interaction entre ciseaux tarifaires et régulation de l'accès

1.4.2.1 Introduction

L'interaction entre régulation ex-ante et politique de la concurrence ex-post, particulièrement pour les abus de position dominante, est un sujet critique parmi les économistes. Plus précisément, comprendre les impacts de la régulation ex-ante sur les incitations à mener des abus de position dominante est un sujet important. Dans ce chapitre, j'étudie le lien entre régulation de la charge d'accès d'une firme en place, verticalement intégrée et en situation de monopole sur le marché amont, et ses incitations à mener des ciseaux tarifaires afin d'évincer un concurrent du marché aval.

En effet, lorsque que l'autorité de régulation indépendante augmente la charge d'accès que l'entrant aval doit payer à la firme en place intégrée pour son produit de gros, cela augmente le profit de gros de la firme en place, donc réduit ses incitations à évincer du marché aval son concurrent. Mais, cela augmente également le coût marginal perçu de l'entrant, et, ainsi, diminue le *coût* pour la firme intégrée de pratiquer des ciseaux tarifaires.

Cet arbitrage a déjà été étudié dans la littérature par Biglaiser and DeGraba [2001] dans un modèle avec des biens différenciés et une concurrence par les prix en tarifs binômes. Je montre ici que leur résultat, qui est qu'une augmentation de la charge d'accès réduit toujours les incitations au squeeze, n'est pas robuste à une autre modélisation.

1.4.2.2 Modèle

La firme en place I est verticalement intégrée, et possède des coûts marginaux aval c_I et amont c_u. Un entrant aval E possède un coût marginal constant $c_E < c_I$, et doit acheter le produit de gros de I au prix fixé par le régulateur. Le facteur d'escompte de la firme en place est $\delta \geq 0$.

Une autorité indépendante régule le marché amont, et fixe la charge d'accès a au produit amont de I pour tout le jeu, avec $a > c_u$. Les consommateurs sont représentés via un fonction de demande $D(p)$.

Suivant le concept de la “long purse” (voir Motta [2004], p. 413), l'entrant ne peut pas subir de grosses pertes lors de la première période du jeu, contrairement à la firme en place. Ainsi, la firme en place peut fixer un prix bas, afin de forcer l'entrant à faire de grosses pertes ou de ne pas vendre son produit, et ainsi de l'obliger à quitter le marché. En résumé, j'assume que si E ne vend pas ou fait un profit égal ou inférieur à $-\gamma \leq 0$ dans la première période, il doit quitter le marché, et I se retrouve en position de monopole dans la deuxième période.

Le timing est le suivant. Dans la première période, les firmes fixent leurs prix, puis les consommateurs font leur choix. Si E ne vend pas ou fait un profit inférieur ou égal à $-\gamma \leq 0$, il quitte le marché. Dans la seconde période, les firmes fixent leurs prix (E seulement s'il est toujours sur le marché), puis les consommateurs font leur choix.

1.4.2.3 Analyse et résultats

Dans un premier temps, ce modèle permet de comparer les profits de I lorsqu'il pratique des ciseaux tarifaires ou non. Lorsqu'il ne pratique pas de ciseaux tarifaires, son profit est $\Pi^{NS} = (1+\delta)\pi^{NS}$, avec $\pi^{NS} \equiv (a - c_u)D(a + c_I)$. Par contre, lorsqu'il pratique les ciseaux tarifaires, son profit est $\Pi^S = \pi^S + \delta\pi_I^m$, avec $\pi^S \equiv (\hat{p} - (c_u + c_I))D(\hat{p}) \leq \pi^{NS}$, et π_I^m le profit de monopole. Le profit lors de la pratique du squeeze dépend du prix *squeezant* $\hat{p}$, défini par $(\hat{p} - (a + c_E))D(\hat{p}) = -\gamma$. Ce prix existe, est unique, et est inférieur à $a + c_E$.

Dans un second temps, ce modèle permet d'analyser les incitations à entreprendre des ciseaux tarifaires, et leur relation avec la charge d'accès. Dans la version complète du chapitre, il est démontré que les incitations, qui dépendent du taux $\partial\hat{p}/\partial a$ auquel une augmentation de la charge d'accès est transmise au prix squeezant, peuvent diminuer ou augmenter avec la charge d'accès.

1.4.2.4 Discussion

Ce chapitre permet donc de remettre en question un résultat établi de la littérature, en montrant qu'il n'est pas robuste à une nouvelle modélisation. Le résultat principal de ce chapitre, qui est que les incitations à pratiquer des effets de ciseaux tarifaires peuvent augmenter ou diminuer en la charge d'accès régulée, est basé sur un modèle de concurrence homogène, avec un minimum d'hypothèses sur la demande.

Ce résultat est robuste lorsqu'on considère d'autres prix d'équilibre que celui sélectionné (il existe un continuum de prix d'équilibre dans ce modèle), que l'entrant doit faire un profit positif dans la première période pour survivre, que les contraintes financières de l'entrant dépendent de la charge d'accès, que la charge d'accès régulée est modifiée d'une période à l'autre, et que l'entrant peut s'affranchir de sa dépendance à la firme en place en construisant son propre réseau amont.

1.5 Conclusion

Dans cette thèse sur articles, j'ai analysé différentes problématiques liées à la régulation et la politique de la concurrence dans le secteur des TIC. La première partie de recherche porte sur deux questions liées à la régulation ex-ante dans le secteur des télécommunications: l'échelle de l'investissement, et les tests d'effet de ciseaux tarifaires effectués par les régulateurs de télécommunications en Europe. La deuxième partie de recherche porte sur deux questions liées à la politique de la concurrence dans le secteur des TIC: la pratique de la vente liée dans certains marchés de télécommunications, et l'organisation industrielle du secteur du livre électronique. Enfin, la troisième et dernière partie de recherche porte sur l'interaction entre régulation ex-ante et politique de la concurrence ex-post, en abordant le cas d'effet de ciseaux tarifaires dans une industrie régulée. Deux questions sont traitées: Pourquoi une firme peut-elle pratiquer un effet de ciseaux tarifaires de manière rationnelle? Et comment évolue l'incitation à entreprendre des ciseaux tarifaires avec la charge d'accès régulée?

En conclusion de cette thèse, je mets en avant certains problèmes liés au secteur des TIC. Ainsi, la régulation ex-ante dans le secteur des télécommunications pourrait plus se baser sur des analyses économiques concrètes, et la politique de la concurrence dans le secteur des TIC pourrait plus régulièrement prendre en compte les spécificités de ce secteur. Enfin, l'application de la politique de la concurrence ex-post dans un marché régulé ex-ante devrait se faire en s'assurant qu'il n'existe pas de conflit entre les deux actions, et que les externalités induites par les régulations sont bien internalisées.

Part II

Introduction

Chapter 2

Introduction

2.1 Regulation and competition policy in the ICT sector

The Information and Communications Technology (ICT) sector embraces a combination of manufacturing and services industries that "capture, transmit and display data and information electronically," according to the Organisation for Economic Co-operation and Development (OECD).[1] The concerned manufacturing industries are those whose products are related to information processing and communication, or which use electronic processing. Products of the concerned services industries are intended "to enable the function of information processing and communication by electronic means," according to the OECD report.

The ICT sector is of particular interest to an industrial organization economist. First, it is in constant evolution, as there are many innovations in the ICT sector. Hence, it is not a static field of study. For instance, the upcoming of the internet in the past 20 years has provided a deep and furnished new area of analysis for economists. Second, the industrial organization in this sector is often particularly complex. One can observe many oligopolistic structures, with vertical relation, innovation and investment strategies, etc. The ICT sector is also often characterized by specificities one does not commonly observe in other sectors, such as network effects (see Rohlfs [1974]).

Third, the ICT sector impacts many other sectors, and therefore contributes

[1] "Measuring the Information Economy," OECD, 2002.

significantly to economic growth. Indeed, all industries are using ICT products or services such as telecommunications equipments and services. In this regard, the ICT sector is a central piece of the economy at large. Jorgenson [2001] explains that the development of information technologies impacts growth via two different channels in the U.S., as it creates a temporary shock on growth, and also leads to permanent improvements in growth prospects. Oliner and Sichel [2000] show that both the use and the production of ICT-related services and products have significantly and positively impacted economic growth in the U.S. in the late 1990s. But the link between ICT and growth is not specific to the U.S. Colecchia and Schreyer [2002] find that ICT contributed significantly to economic growth in the late 1990s in every country they analyzed (Australia, Canada, Finland, France, Germany, Italy, Japan, the United-Kingdom, and the U.S.).

At the core of the ICT industry, telecommunications infrastructures play an important role in contributing to economic growth. Using a panel of 21 OECD countries over 20 years, Röller and Waverman [2001] demonstrate that telecommunications infrastructure investments had a significant and positive impact on economic growth when reaching a critical mass level. More recently, Czernich *et al.* [2011] study 31 OECD countries and show that broadband penetration has had a positive and significant impact on economic growth over the period 1998-2010.

Finally, the ICT sector is at a crossroad between ex-ante and ex-post regulations, and both types of regulation typically play an important role in the telecommunications industry (see Laffont and Tirole [2001]). Therefore, it is not only interesting to study the impact of these two types of regulation in this sector, but also to analyze the interplay between both forms of regulation, each of them having its own particularities.

The telecommunications industry, the network ground for the ICT sector, has had a particular economic history in the past decades. As other network industries in other sectors (such as energy, or utilities), it experienced a rapid growth due to national investment plans settling down large state-owned incumbent firms.

Then, many countries decided to liberalize (fully or partially) their telecommunications industry. At the European level, early decisions for fixed telecommunications concerned the liberalization of cable TV networks in 1995, or the unbundling of the local loop which became mandatory at the European level in

2000.

Parallel to this liberalization of the industry, specific regulatory rules have been implemented, both at the national level by National Regulatory Authorities (NRAs) and at the international level. These rules aim at maintaining a level-playing field in the industry, in order to introduce competition while supplying firms with sufficient margins to ensure investments, national specific regimes through Universal Service Obligations (USOs), or to avoid inefficient duplication of natural monopoly infrastructures.

Besides these specific regulatory rules, the ICT sector, as any other economic sector, is also subject to competition policy. Whereas the industry-specific regulations impact the sector ex-ante, competition policy plays a role ex-post in prohibiting abuse of a dominant position.[1] These ex-post rules are mainly enforced through an authorization and/or punishment system, defining what are the legal rules of competition.

In this thesis, I address these specificities of the ICT sector by studying some aspects of regulation in the telecommunications industry, some firms' strategies which have been investigated by competition authorities in the ICT sector, and some firms' conducts which have been investigated by competition authorities in ex-ante regulated telecommunications markets. I characterize several features of ex-ante and ex-post regulation, and show that some of the main advantages of ex-ante regulation correspond to some of the main weaknesses of ex-post competition policy, and *vice-versa*.

2.1.1 Regulation in the ICT sector

As other network industries, the ICT sector, and the telecommunications industry in particular, has been liberalized in many countries over the past decades. The liberalization process has moved the industry from a fully regulated monopoly to a partially regulated market, with an incumbent generally facing (less) partially regulated entrants. Overviews of the liberalization and deregulation processes can be found in Waverman and Sirel [1997] for Europe, Harris and Kraft [1997] and Crandall [2000] for the U.S., and Spiller and Cardilli [1997] for some other

[1]Note that competition policy also plays a role ex-ante, for instance in merger review. However, we will focus on its ex-post role in this thesis.

countries (Australia, Chile, Guatemala, and New Zealand).

The main goal of the liberalization process was to introduce competition in monopolized and regulated markets. Indeed, competition is generally thought to foster innovation and growth, as explained by Aghion *et al.* [2005]. The authors argue that there is an inverted U-shaped relationship between competition and innovation. On the one hand, more competition may foster innovation and growth when it induces a larger decrease in a firm's pre-innovation rents than in its post-innovation rents. This is particularly true in sectors where firms are competing at similar technology levels and the incremental profit from innovation is large. On the other hand, when innovations are made by laggard firms and therefore competition mainly affects post-innovation rents, the 'Schumpeterian effect' of competition dominates.

In this regard, liberalized ICT industries are thought to perform better than non-liberalized ones in contributing to growth in the sector. Besides, regulatory authorities might be captured by political or private institutions, and, hence, regulated industries might perform poorly when compared to liberalized ones. Indeed, as Levy and Spiller [1994] explain, the sector's economic performance is affected by interactions between political institutions and regulatory processes or economic conditions, hence giving room for administrative manipulation.

This impact of liberalization and deregulation on growth has been empirically verified by Olley and Pakes [1996], who find an increase in the rate of aggregate productivity growth of the U.S. telecommunications equipment industry after deregulation. The authors explain that this productivity increase was primarily due to capital reallocation towards more productive plants. Similarly, Li and Xu [2004] find that full privatization, which gave private owners control rights, contributed substantially to growth in the telecommunications sector. Indeed, full privatization increased competitive pressure and, hence, raised both factor inputs and total factor productivity.

This increase in productivity after liberalization may also be explained by former regulation-induced inefficiencies. To analyze these inefficiencies, Hausman [1997] and Prieger [2002] estimate the effects of regulation of new telecommunications services. They find a negative impact of regulation of new services on welfare, mostly due to delays for regulatory approvals (firms also face direct costs from preparing approval plans, and these plans might reveal some information to competitors).

However, the liberalization process did not aim at introducing competition in all market segments. Instead, as highlighted by Curien and Gensollen [1989], it generally aimed at introducing competition in a previously monopolized market, while avoiding inefficient duplication of natural monopolies. Therefore, the industry may perform better as a whole when competition is introduced in some market segments only, and regulation of the natural monopoly market is maintained.

Additionally, privately controlled firms issued from the liberalization process do not behave strategically like state-owned firms. Bortolotti *et al.* [2011] study more than 90 publicly traded firms in the European Union from 1994 to 2005 and show that privately controlled firms rely on leverage more than state controlled firms.[1] This drastically impacts market outcomes, as leverage positively influences regulated retail prices when firms are privately controlled (Bortolotti *et al.* [2011]), as well as regulated wholesale prices and incumbent market shares (Cambini and Rondi [2012]).

Besides, regulation is in general a efficient way to solve market failures as, for instance, to promote interconnection between networks (see, e.g., Armstrong [1998] and Laffont, Rey and Tirole [1998]). A complete overview of the theory of regulation is given in greater details in Armstrong and Sappington [2007], while Lévêque [2009] provides a clear examination of regulation of externalities, natural monopoly, and collective goods with concrete examples.

One example of regulation in the telecommunications industry is the regulation of access pricing (see, e.g., Armstrong [2001, 2002], and Vogelsang [2003]). In fixed telecommunications networks, the last mile of the physical network is generally considered as a natural monopoly, as it might be too costly to duplicate. However, competition can be introduced in other market segments, such as service provision to final consumers. Hence, many regulatory authorities have enforced access regulation rules for incumbent firms to rent the last mile of their fixed telecommunications network (the "local loop") to their competitors in the retail market. In Europe, for example, unbundled access of the local loop is mandatory since December 2000 and the regulation No 2887/2000 of the European Parliament and the Council.

However, regulation also has some drawbacks, especially due to its poten-

[1] Cambini and Spiegel [2012] provide a theoretical justification of this result.

tially negative impact on investment (see, e.g., Valletti [2003]; and the reviews by Guthrie [2006], and Cambini and Jiang [2009]). Also, the interplay between regulated and non-regulated networks can be difficult to dealt with for a regulatory authority (Hausman, Sidak and Singer [2001]). This is particularly true in broadband markets where DSL networks are regulated in order to favor entry, whereas cable networks are not. For instance, in OECD countries, competition between DSL and cable networks (inter-platform competition) brings higher broadband penetration rates than intra-platform competition on the DSL network (Bouckaert, van Dijk and Verboven [2010]).[1] Finally, some anticompetitive conducts might arise when a regulated firm integrates into a non-regulated segment (see, e.g., Rubinfeld and Singer [2001]).

2.1.2 Competition policy in the ICT sector

The ICT sector, as any economic sector, is subject to competition policy (or antitrust). There is a long history of competition policy and its relation with economic theory. Posner [1976] and Bork [1978] were among the first to introduce economic and industrial organization models to justify or dismiss antitrust regulations in the U.S. Their work mainly aimed at demonstrating with simple economic models why many strategic conducts which were thought to be anticompetitive are not rational unless they had a positive impact on welfare. Ever since, a major part of the IO competition policy literature has aimed at introducing different real-world assumptions in these simple models, in order to rationalize anticompetitive strategic conducts.

The theory of competition policy is developed in greater details by Rey [2003], and Motta [2004]. Both authors provide detailed reviews of all aspects of com-

[1]Distaso, Lupi and Manenti [2006] study European countries and find similar results. Also studying European countries, Höffler [2007] finds that inter-platform competition increases broadband penetration but that the total effect on social welfare may be negative when incorporating fixed costs in the analysis. Using micro-data for the United-Kingdom, Nardotto, Valletti and Verboven [2012] show that intra-platform competition does not impact broadband penetration, in contrast to inter-platform competition, and that both types of competition positively impacts service quality. Note that, however, Gruber and Koutroumpis [2013] find an opposite result estimating the impact of inter- and intra-platform competition on broadband penetration in a larger dataset of 167 markets over 11 years. They explain their result by the fact that bypass of the incumbents' networks is costly, and that this cost is passed through to final consumers.

petition policy, and in particular of all the anticompetitive conducts a dominant firm can undertake.

Two main approaches driving competition policy are used by different authorities all over the world: the form-based and the effect-based approaches. The former bases competition policy decisions on simple and clearly-defined tests and rules that authorities, firms, and organizations can easily apply. The latter bases decisions on the current effects on welfare or consumer surplus that (allegedly) anticompetitive conducts may have. An economic approach to competition policy law in Europe is given by Gual *et al.* [2006]. The authors argue for a move toward more effect-based decisions in competition policy.

Both approaches have advantages and drawbacks. While the form-based approach allows for an homogeneous understanding of rules across the whole industry, it can also favor false positive (type-I) errors when the rules are 'too tough' such that they prevent firms to compete fiercely. By contrast, the effect-based approach reduces the scope for false positive errors, but allows for a wider range of conducts and strategies. Furthermore, implementation of an effect-based approach may necessitate a closer analysis from regulatory authorities, which are resource-constrained, and hence, may favor false negative (type-II) errors.

The differences between these two approaches can help to explain the differences between authorities when studying pricing conducts such as predation or margin squeeze. For instance, as we will argue in Chapter 7, if predation were defined according to an economics-based definition (and not a form-based one), margin squeeze cases in regulated markets could generally be analyzed as predatory conducts.

Furthermore, the ICT sector has a lot of specificities when compared to other sectors. For instance, markets in the telecommunications industry are often organized according to vertical structures. Besides, there are strong asymmetries between former state-monopolies and new entrants. These vertical structures and asymmetries may facilitate anticompetitive conducts from dominant firms, with the goal to exclude competitors or to earn supra-competitive profits (see, e.g., Inderst and Valletti [2011], or Bourreau *et al.* [2011]). Some aspects of competition policy are dedicated to the analysis of these vertical relationships with dominant firms (see, e.g., Rey and Tirole [2007], Rey and Vergé [2008], or Riordan [2008] for detailed reviews).

2.1.3 The interplay between regulation and competition policy in the ICT sector

When ex-ante regulation and ex-post competition policy are applied in the same market, the interplay between them may induce specific conducts from firms and may necessitate an ad-hoc analysis. More precisely, the interactions between both forms of regulation may be complicated.

As a simple example, let us consider the AT&T break-up in 1982 in the U.S., known as the Bell doctrine. At that time, AT&T was divided into several companies because sectoral regulation, which required the incumbent to allow entrants to access its network at a given price, was potentially a source of anticompetitive conducts. Indeed, even if a vertically-integrated incumbent prefers to serve a more efficient downstream competitor rather than to serve the retail market itself if the wholesale price is high enough, it may prefer to set up anticompetitive conducts to foreclose the market when the wholesale price is regulated and does not allow it to earn supra-competitive profits (see Joskow and Noll [1999]). In this case, the anticompetitive conduct might have appeared because the market was regulated, whereas it would have not occurred if the market had stayed unregulated.

This complicated interplay might be explained by several factors. As Perrot [2002] points out, sectoral regulatory and competition authorities have different objectives, tools, and procedures. Besides, they also differ according to the information they can acquire, the timing of their interventions, their commitment ability, how much they have to rely on past decisions, and the risk of regulatory capture (see also Choné [2006]).

In a theoretical paper, Aubert and Pouyet [2004] model the relationship between both authorities in an industry where a dominant firm faces a potentially collusive competitive fringe. They show that when the dominant firm's and its competitors' goods are complementary, ex-post regulation from a competition authority might outperform ex-ante regulation. However, the results are ambiguous when goods are substitutes, and ex-ante regulation may be better when they are strong substitutes because of the distortionary taxation used to finance the subsidy paid to the regulated firm.

Hence, the optimal organization between ex-ante and ex-post regulations might be hard to determine.[1] In Europe, the European Commission regulates the telecommunications industry with the view that sectoral regulation aims at building a competitive framework, whereas competition policy ensures that the resulting competitive equilibrium is maintained. To this end, sectoral regulation in the telecommunications industry should migrate from supervising all markets to concentrate on specific issues at the wholesale level only, thereby leaving retail markets unregulated and competitive. This point of view allows for the competition authorities' intervention in ex-ante regulated markets.

By contrast, the U.S. view is much more restrictive, and antitrust laws are rarely applied in markets with sectoral regulation, notably because the Supreme Court claims that this is not the role of antitrust to set (ex-ante) sectoral regulations that would necessitate a deep analysis and a continuous control of the industry.

This difference is striking in recent competition policy cases, such as those on margin squeeze conducts. Indeed, the European Commission recently adopted several decisions, declaring as anticompetitive some pricing conducts from telecommunications incumbents, such as in the cases *Commission of the European Communities v. Deutsche Telekom* (Case COMP/C-1/37.451, 37.578, 37.579), and *Commission of the European Communities v. Telefonica* (Case COMP/38.784). By contrast, the U.S. Supreme Court decided not to enforce ex-post rules in an ex-ante regulated market in the case *Pacific Bell Telephone Co. v. linkLine Communications, Inc.* (Case 129 S. Ct. 1109). We will study issues related to margin squeeze in more details in this thesis, and provide a summary of the case law in Chapter 7.

More generally, in the telecommunications industry, some authors study the differences between both types of regulation, or the relation between them. As an example, Heimler [2010] study the interplay of ex-ante and ex-post interventions in the case of a margin squeeze abuse, asking whether a margin squeeze is a regulatory or an antitrust abuse. He argues in favor of the "European" point of view, explaining that a margin squeeze in a regulated market should be considered

[1] For instance, Hiriart, Martimort and Pouyet [2004] consider a game with adverse selection incentive problem with a firm engaging in activities that are potentially risky for the environment, an ex-ante regulatory authority, and an ex-post judge which can evaluate values from damage. They show that the first-best level of care can be implemented ex-ante only when this level is observable by the regulatory bodies.

as abusive by competition authorities, because sectoral regulatory authorities might not have enough tools to prevent margin squeeze and to promote investment simultaneously.

2.2 Research questions and results

In this section, we briefly review the research questions and results of this thesis. For each part of the thesis, we will focus on issues related to regulation in the telecommunications industry, competition policy in the ICT sector, and the interplay between regulation and competition policy in network industries. We do not claim to bring a broad picture, but instead to address specific problems which are good illustrations of more general issues.

2.2.1 Regulation in the telecommunications industry

The first two research chapters of this thesis address issues related to regulation in the telecommunications industry.

2.2.1.1 Dynamic entry and investment in new infrastructures: Empirical evidence from the telecommunications industry

The relationship between competition and innovation or investment has attracted a lot of attention from economists. A standard prediction in the theoretical literature is that, starting from a non-competitive situation, intensifying competition may undermine innovation or investment incentives.[1] This result has strong policy implications for regulated industries (like telecommunications, energy, transportation, etc.): it means that regulators may face a trade-off between stimulating competition and providing industry players with incentives to invest (in infrastructures, the design of new services, etc.).

The telecommunications industry provides a vivid example of this regulatory trade-off. In this industry, alternative operators compete in two different ways with incumbent operators: on the basis of services, when they rent access to the incumbents' networks, and on the basis of facilities, when they build their own

[1]See, for instance, Aghion *et al.* [2005] who find an inverted-U relationship between competition and innovation.

facilities to provide services to end customers. Facility-based competition is generally considered as the only means to achieve sustainable competition, because it provides more possibilities for service and product innovations than service-based competition, and it could lead to a (partial) deregulation of the sector. However, facility-based competition is difficult to develop rapidly because of the high sunk costs that new entrants have to bear. This is why, in many European countries, regulators have set the terms of access to incumbents' infrastructure with the view of favoring service-based competition and allowing entrants to enter the market rapidly.

In the telecommunications industry, the ladder of investment approach claims that service-based competition (when entrants lease access to incumbents' facilities) can serve as a "stepping stone"for facility-based entry (when entrants build their own infrastructures to provide services). In Chapter 3, we build an empirical model considering a complete ladder of investment, composed of three rungs: bitstream access, local loop unbundling and new access facilities.[1] Using data from the European Commission "Broadband access in the EU" reports covering 15 European member states for 17 semesters, we test the ladder hypothesis. We find no empirical support for this hypothesis, that is, for the migration from local loop unbundling to new access infrastructures, and weak empirical support for the transition from bitstream access lines to local loop unbundling. These results are robust when we take into account the number of access rungs, the development of broadband cable, the regulatory performance, and the evolution of local loop unbundling prices.

2.2.1.2 Ex-ante margin squeeze tests in the telecommunications industry: What is a Reasonably Efficient Operator?

As they generally have to pursue multiple objectives while using a limited number of tools, ex-ante regulatory authorities often build complex models in order to regulate telecommunications markets. For example, European regulatory authorities commonly test ex-ante whether or not the margin set between the access charge (which may be regulated) and the incumbents' retail prices is higher than the incumbent's downstream cost.

[1] Chapter 3 is adapted from a joint paper with Maya Bacache and Marc Bourreau (Bacache, Bourreau and Gaudin [2013]).

Implementing a margin squeeze test may serve different regulatory purposes, such as the regulation of the access charge for instance. In this view, the European Commission, which acts as an ex-ante and ex-post regulatory authority, has introduced some guidelines in order to define more precisely such ex-ante tests. However, these guidelines provide a large degree of flexibility when it comes to their actual implementation.

In Chapter 4, we study the implementation of 'reasonably efficient operator' margin squeeze tests by National Regulatory Authorities in European telecommunications markets.[1] We provide a theoretical framework in which we show how regulatory authorities deal with the asymmetries between entrants and incumbents by adjusting the 'equally efficient operator' margin squeeze test used in competition policy. Using this framework, we build a benchmark of implementation choices by inspecting authorities' guidelines, market analyses and decisions. We find that some implementation choices are very similar across authorities' decisions, whereas some others are dealt with a strong heterogeneity.

2.2.2 Competition policy in the ICT sector

Chapters 5 and 6 address different issues related to competition policy in the ICT sector.

2.2.2.1 Bundling with switching costs

Bundling –the strategy of selling several products or services together– has attracted a lot of research in the past 20 years. There is a long competition policy debate about product bundling and other similar strategies, such as tying. For instance, in the U.S., product bundling had been forbidden for a long time, because of its possible anticompetitive and exclusionary effects. However, in the 1970s, economists from the Chicago school such as Posner [1976] demonstrated that bundling was not a rational strategy unless it was welfare-improving (because of cost reductions, for instance). Since this view emerged, many economists have built models in order to show that, under some assumptions, bundling can be a profitable exclusionary strategy (see, e.g, Whinston [1990]), in contrast to what the Chicago school predicts.

[1] Chapter 4 is a joint paper with Claudia Saavedra (Gaudin and Saavedra [2012]).

In parallel, a whole line of the literature on bundling has developed to explain why this selling strategy can also be profitable without competitors' exclusion (see, e.g., Carbajo, de Meza and Seidmann [1990]). Overall, the multiplicity of anticompetitive and fair justifications for bundling makes it a tedious task for competition authorities when analyzing bundling strategies, as they have to understand precisely the economic mechanisms at stake to assess whether this conduct is legal or not.

In Chapter 5, we introduce a new rationale for pure bundling, solely based on the presence of switching costs.[1] We develop a two-period model in which a firm might set up asymmetric switching costs by bundling its products together. When the switching costs are high and the consumers' valuation for the monopoly product is low, bundling is a dominant strategy. Indeed, in this case, the bundling firm can exploit locked-in consumers in the competitive market while incurring only small losses in the monopoly market. However, total welfare decreases with bundling.

2.2.2.2 On the antitrust economics of the electronic books industry

The electronic book (ebook) market has grown rapidly in the past couple of years. Amazon, the online giant book seller currently sells more ebooks than print books. However, since the launch of the iPad by Apple in 2010, Amazon's supremacy in the ebook market has been challenged by this new competitor.

Recently, U.S. and European competition authorities have investigated possible anticompetitive conducts in the ebook market following the introduction of the iPad. When Apple entered the market, it introduced a new type of contract with the main book editors: the agency contract. According to this contract, the editors are able to set the retail price of ebooks, and Apple earns a share of revenues. This is very different from the model that was used by Amazon, which was buying ebooks at a wholesale price and setting its own retail price. In this regard, U.S. and European competition authorities recently agreed that Apple and the major editors colluded on the type of contracts they used, and decided to take some actions against this collusive behavior.

In Chapter 6,[2] we explain that the recent antitrust investigations in the ebook

[1] Chapter 5 is adapted from the paper by Gaudin [2012].

[2] Chapter 6 is a joint paper with Alexander White (Gaudin and White [2013]).

markets, both in the United States and the European Union, failed to take into account an important feature of these markets; namely that access to ebooks is only available after the purchase of a reader device. Interestingly, in this market, ebook resellers (i.e., Amazon and Apple) also sell devices to read ebooks. We demonstrate that this specific market structure plays an important role on the difference between ebook prices when agency or wholesale contracts are used.

2.2.3 The interplay between regulation and competition policy: the case of margin squeeze

The last two research chapters of this thesis analyze the interplay between regulation and competition policy in regulated industries, for a specific conduct: margin squeeze.

2.2.3.1 Margin squeeze and monopoly maintenance in regulated industries

For economists, it might be puzzling at first when a vertically-integrated firm refuses to sell its monopoly upstream input to a more efficient downstream competitor. Indeed, the Chicago school argument states that, as there is only one monopoly profit to be earned, the vertically-integrated firm should serve its downstream competitor and extract all additional surplus through the upstream input price. However, several vertically-integrated incumbents have been condemned for, or accused of undertaking margin squeeze strategies to foreclose downstream competitors. For the theory to match precisely with competition policy, economists should be able to explain why such conducts of foreclosure are rational.

Interestingly, in many of recent margin squeeze cases, the upstream market was ex-ante regulated by a sectoral authority (a detailed review of these cases is provided in Chapter 7). Hence, one could wonder what is the role of ex-ante regulation in characterizing anticompetitive conducts into margin squeeze cases? Also, one might wonder whether or not authorities should consider margin squeeze as an anticompetitive conduct in an ex-ante regulated market.

In Chapter 7 we study margin squeeze as an entry-deterrence strategy.[1] We

[1] Chapter 7 is adapted from the paper by Gaudin [2013a].

show that a vertically-integrated incumbent might undertake a margin squeeze in order to deter a more efficient entrant when the access charge is regulated above cost, following the vertical dynamic defensive leverage argument. We also explain why a margin squeeze should be considered as a stand-alone anticompetitive abuse, when the access charge is ex-ante regulated.

2.2.3.2 The interplay between margin squeeze and regulation

When studying margin squeeze conducts in ex-ante regulated markets, one should wonder what is the impact of the regulated access charge on the vertically-integrated incumbent's incentive to undertake a margin squeeze. Indeed, since the Bell doctrine, economists know that regulation can induce anticompetitive conducts that would not take place in a non-regulated market. Biglaiser and DeGraba [2001] study the impact of the access on the incentive to engage in a margin squeeze strategy. using a specific market model, they find that the incentive to undertake a margin squeeze always decreases in the access charge.

In Chapter 8, we show that this result is not robust to alternative modeling assumptions. We analyze the impact of access regulation on a firm's incentive to abuse of its dominant position.[1] We study the incentive for a vertically-integrated incumbent whose access charge is regulated to undertake a margin squeeze in order to eliminate a downstream competitor. An increase in the access charge has two opposite effects: it increases the incumbent's upstream profit under fair competition, and also lowers the cost of abusing of its dominant position. We show that, when the discount factor is low enough, the latter effect may dominate, and an increase in the access charge can then increase the incumbent's incentive to undertake a margin squeeze. Hence, a regulatory authority should carefully monitor possible anticompetitive conducts when raising the regulated access charge. Our general results extend the previous findings on the interplay between the incentive to engage in a margin squeeze and access regulation.

[1] Chapter 8 is adapted from the paper by Gaudin [2013b].

2.3 Thesis plan

The reminder of this thesis is as follows. In Part III we will study issues related to regulation in the telecommunications industry in Europe. More precisely, we will estimate the impact the “ladder of investment” regulatory approach in the fixed broadband market in Chapter 3, and we will review the adjustments made by regulatory authorities on their ex-ante margin squeeze tests in Chapter 4.

In Part IV we will study issues related to competition policy in the ICT sector. In Chapter 5 we will explain why bundling can be a profitable strategy in market with switching costs, such as the mobile telephony market, and we will study the associated welfare effects. In Chapter 6 we will bring a new perspective to the on-going antitrust cases in the electronic book markets in the U.S. and in Europe.

In Part V, we will study the interplay between regulation and competition policy in the telecommunications industry, by analyzing the case of margin squeeze. We will explain why margin squeeze can be a rational exclusionary strategy in ex-ante regulated markets in Chapter 7, and we will analyze the impact of ex-ante access regulation on the incentive for an incumbent to undertake a margin squeeze in Chapter 8. Furthermore, we will explain in Chapter 7 why margin squeeze in regulated markets should be considered as an anticompetitive conduct and should be dealt with by competition authorities ex-post.

Finally, in Part VI, we will conclude this thesis. We will provide a clear summary of the research questions and analyses addressed in this thesis, and we will formulate some directions for future research as well.

Part III

Regulation in the telecommunications industry

In this first research part of this thesis, we analyze research questions relative to ex-ante regulation in the telecommunications industry. In this industry in which investments in new technologies play an important role, regulatory authorities generally face a static vs. dynamic efficiency trade-off. Indeed, regulatory authorities may simultaneously want to increase competition by allowing new established firms to access the incumbent's bottleneck input in order to enhance consumer surplus and welfare in the short-term (static efficiency), while maintaining sufficient incentives to invest for the incumbent, the entrants, or both, in the long-run (dynamic efficiency).

In Chapter 3 we provide an empirical test of the ladder of investment hypothesis, which builds on a widespread regulation in European fixed telecommunications markets. This regulation aims at resolving the static vs. dynamic efficiency trade-off by providing a special type of one-way access regulation to entrants within a given technology infrastructure (Digital Subscriber Line, DSL). The main goal of this regulatory approach is to favor entrants' investments in the long run. We demonstrate that the ladder of investment hypothesis is not satisfied. In other words, the overall impact of the ladder of investment on entrants' investments in the long run, which aggregates the replacement effect and the ladder of investment effect, is not statistically different from zero. However, this regulatory approach allows entrants to invest progressively within a given technology infrastructure owned by the incumbent (namely DSL), up to the local loop.

In Chapter 4 we study when and how regulatory authorities do use ex-ante margin squeeze tests in order to set access rules to telecommunications incumbents in Europe. We build a theoretical framework that allows us to benchmark regulatory authorities' choices in modeling 'Reasonably Efficient Operators' (REOs) in margin squeeze tests. We find that further guidance at the European level might be needed for harmonization between countries, as some implementation choices are very similar across authorities' decisions, whereas some others are dealt with a lot of heterogeneity. Indeed, some regulatory authorities encourage entry in the short run through their implementation choices, whereas some others are more conservative as they model REO tests that are more favorable to incumbents, often with a view to support their long-run investment incentives.

Overall, in Part III we demonstrate that ex-ante regulatory intervention in telecommunications markets in Europe may be challenging in that it might be complicated because of the unforeseeable nature of regulatory rules and their outcomes. Indeed, a regulation applied without proper economic analysis might turn to be inefficient (as the ladder of investment for instance), and vague regulatory rules (as rules defined by the European Commission for margin squeeze tests) might induce very different outcomes when they allow for large implementation possibilities.

Chapter 3

Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Telecommunications Industry

3.1 Introduction

In network industries (like telecoms, energy, transportation, etc.), regulators often face a trade-off between stimulating competition and providing industry players with incentives to invest (in infrastructures, the design of new services, etc.). For example, in the telecommunications industry, there has been a heated debate as to whether the development of service-based competition may come at the cost of delaying facility-based entry.[1] A standard view is that, if entrants start renting access to the incumbent's infrastructure at favorable conditions, the entrants have an additional opportunity cost for investing in new access infrastructures, and hence, service-based competition can indeed delay facility-based entry.[2]

The "ladder-of-investment" approach (Cave [2006]) proposes to solve this

[1]Service-based competition takes place when entrants rent access to the incumbents' networks (via local loop unbundling, for example), whereas there is facility-based competition when the entrants build their own infrastructures to provide services to end customers. See Section 3.2 for more details on the industry background.

[2]See, for instance, Crandall, Ingraham and Singer [2004].

dilemma. This approach argues that access regulation is not only pro-competitive because it reduces barriers to service-based entry, but that it is also an indirect device to promote facility-based entry. The idea is that, by setting low access prices, the regulator encourages service-based entry in the short term. Then, once entrants have gained a customer base and acquired market experience, they can climb up the ladder-of-investment and invest in their own facilities.[1] Hence, according to this approach and in contrast with the standard view, service-based competition could serve as a stepping stone for facility-based entry, which we refer to as the "ladder-of-investment hypothesis."[2]

Though most European countries regulate access to the incumbents' local networks with the ladder-of-investment approach in mind,[3] the effectiveness of this approach has never been evaluated. In this paper, we build an econometric model to test the ladder-of-investment hypothesis. The total number of facility-based lines that are owned by new entrants is our dependent variable, and the total number of service-based (unbundled) lines in previous periods is our main explanatory variable. We estimate our model using data from the European Commission's (EC) "Broadband access in the EU" reports on the number of lines that are owned or used by incumbent and entrant fixed-broadband operators in 15 European member states (EU15) over eight years (Jul. 2002 - Jul. 2010).

We find no evidence in support of the ladder-of-investment hypothesis: that is, no effect of the past number of service-based (unbundled) lines on the number of

[1]See Bourreau, Doğan and Manant [2010] for a critical review of the ladder-of-investment approach. See also Bourreau and Drouard [2010], who study the effect of a phase of experience acquisition on an entrant's investment incentives.

[2]Note that the ladder-of-investment approach is very similar to the stepping-stone hypothesis that has been hotly debated in the United States (e.g., see Rosston and Noll [2002]).

[3]For example, according to the French telecommunications regulatory authority (Autorité de régulation des communications électroniques et des postes, ARCEP) "the development of competition in France since 1998 is a good illustration of the theory of the ladder of investment" (see ARCEP [2007], p. 36). The European Regulatory Group (ERG) also argues that there has been a positive relationship between the implementation of the ladder of investment approach and the pace of development of the broadband market: "[the ladder of investment] explains recent developments in European broadband markets quite well and can serve as a good regulatory model" (ERG [2005], p. 1). As a final example, the European Commission (EC) cited the ladder approach in a decision on squeeze tests conducted by the Italian telecommunications regulatory authority (Autorità per le Garanzie nelle Comunicazioni, AGCOM): "AGCOM's approach [...] may fail to take sufficient account of alternative operators' financial leeway to climb up the ladder of investment throughout the national territory" (Commission decision concerning Case IT/2010/1103: Margin squeeze test guidelines, 6 August 2010).

new access lines owned by entrants. We also consider an alternative specification of the ladder-of-investment hypothesis, with a "short" ladder composed of only two access rungs (bitstream access and local loop unbundling). The idea is that new entrants may invest up to the local loop unbundling rung, but may be unable to replicate the last local loop rung. We find weak empirical support for the ladder-of-investment hypothesis for this short ladder. In the end, our results suggest that the ladder-of-investment approach might be an ineffective instrument to stimulate investment in the telecommunications industry.

The rest of the paper is organized as follows: In Section 3.2, we provide some institutional details and a literature review. In Section 3.3, we describe our test of the ladder-of-investment hypothesis, the econometric specification, and the data, and we provide the estimation results. We present some robustness tests in Section 3.4. Finally, in Section 3.5, we conclude.

3.2 Institutional details and literature review

In this section, we begin by providing some details on the institutional context in the telecommunications industry, and we then review the relevant literature.

3.2.1 Institutional context

The ladder-of-investment approach aims at providing new entrants with a transitory entry assistance, while incentivizing them to build their own access networks in the medium or long run. The regulator begins by giving the entrants an initial "lift up" on the investment ladder by ensuring access to the incumbent's infrastructure at reasonable terms (which leads to service-based competition).[1] Then, through the regulation of access prices, the regulator makes sure that the entrants climb up to the next rung. The process continues until the entrants reach the top of the ladder (i.e., until they by-pass all parts of the incumbent's infrastructure), at which point facility-based competition begins.

Figure 3.1 shows the ladder-of-investment for broadband. An entrant starts to compete on the basis of services under different levels of access (up to the

[1]Here, the "incumbents"refer to the historical fixed-line operators or former monopolies (e.g., France Telecom in France, or Telecom Italia in Italy), and therefore, there is only one incumbent operator in each European country. The "entrants"are the incumbent's competitors.

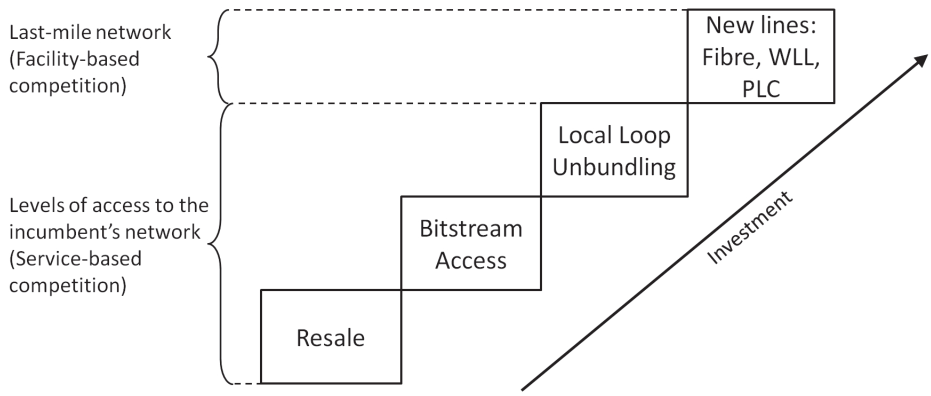


Figure 3.1: The ladder-of-investment and the levels of access

Local Loop Unbundling rung), and eventually invests in an access network with a technology that is compatible with the investment ladder (i.e., fibre, Wireless Local Loop, or Power Line Communications).

In what follows, we begin by describing the levels of access that are available to new entrants at the first rungs of the investment ladder. Then, we present the different access technologies that they can use when they have reached the top of the ladder.

3.2.1.1 The different levels of access under service-based competition

With the ladder-of-investment approach, different levels of access are available on the incumbent's network. The lowest rungs of the ladder, the resale and bitstream access (BA) wholesale offers, allow entrants to enter with limited investment. The highest access rung, local loop unbundling (LLU), requires more investment but also offers more possibilities in terms of innovation and product differentiation.

Resale occurs when entrants purchase the broadband Digital Subscriber Line (DSL) service of the incumbent on a wholesale basis, and commercialize it to customers under their brand names. Bitstream access occurs when the incumbent gives access to its broadband network to third parties. In this case, entrants need to invest in a data network of their own.

Finally, local loop unbundling occurs when the incumbent rents access to its physical copper lines (i.e., the "last mile") to new entrants. With LLU, entrants have to build a core network down to the local exchanges of the incumbent, and to install their own broadband equipment (the Digital Subscriber Line Access Multiplexers, DSLAMs) in the incumbent's local exchanges. There are two forms of LLU: "full" unbundling, when the entrant rents the entire copper line, and "shared" unbundling, when it rents only the upper bandwidth of the line. In this paper, as full and shared LLU access correspond to the same investment rung, we ignore this distinction.

Table 3.1 shows the share of these three levels of access in the EU15 countries in July 2002 and July 2010. As the table shows, entrants have migrated from bitstream access and resale to LLU between July 2002 and July 2010. While LLU has been mandated by the European Regulation 2887/2000,[1] note that no such obligation exists for bitstream access and resale. In each European country, the National Regulatory Authority (NRA) has to decide, based on a market analysis, whether or not to regulate bitstream access and resale. Some European countries have decided to regulate these wholesale offers, but not all.

	LLU (%)	Bitstream access (%)	Resale (%)
Jul. 2002	28.3	31.0	40.7
Jul. 2010	76.8	14.2	9.0

Table 3.1: Share of LLU, bitstream access and resale in the EU15 countries (with respect to the number of subscriber DSL lines served by new entrants). Source: EC COCOM Reports.

3.2.1.2 The development of alternative broadband infrastructures

Instead of leasing access to the incumbent's network, an entrant can also build its own local infrastructure, which leads to facility-based competition. Facility-based competition is generally considered as the only means to achieve sustainable competition, because it provides more possibilities for service and product innovations than does service-based competition, and it could lead to a (partial) deregulation of the sector.[2]

[1] See: Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on unbundled access to the local loop, Official Journal of the European Communities, December 2000, the 30th, available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:336:0004:0008:EN:PDF.

[2] In this vein, Distaso, Lupi and Manenti [2006] provide empirical evidence that facility-based competition has been the main driver of broadband adoption in 14 European countries, from

Different access network technologies exist such as cable modem, optical fibre (fibre to the home, fibre to the building...), power line communication (PLC), wireless local loop (WLL), and satellite.[1] Though the share of the different broadband technologies might differ from one country to another, we can see from Table 3.2 below that cable is the main technology that is used by entrants to provide broadband services in the EU15 countries.

	Cable (%)	Fibre (%)	WLL (%)	Satellite (%)	PLC (%)
Jul. 2002	93.5	4.4	0.3	1.7	0.1
Jul. 2010	91.5	7.0	1.1	0.3	0.01

Table 3.2: Share of alternative broadband technologies in the EU15 countries (with respect to the total number of subscriber lines operated by entrants with an alternative access technology). Source: EC COCOM reports.

Since our focus is the ladder-of-investment approach, we only consider the access technologies that an entrant can use when it has reached the last (LLU) rung: fibre, WLL and PLC.[2] Cable modem and satellite correspond to completely different access technologies, with different network architectures, and hence, they are not compatible with the ladder-of-investment approach.[3] If we exclude cable

2000 to 2004. Similarly, Nardotto, Valletti and Verboven [2012] demonstrate that local loop unbundling had no positive impact on broadband adoption in the U.K. between 2005 and 2009, in contrast to facility-based competition from cable operators. However, a different conclusion is reached by Gruber and Koutroumpis [2013], who study a large dataset of 167 broadband markets over 11 years, and find that facility-based competition has delayed broadband adoption. Höffler [2007] also shows that for the period 2000-2004 in western Europe, the costs that were associated with the inefficient duplication of existing infrastructures outweighed the benefits of increased broadband penetration.

[1]In addition to these technologies, one could include mobile broadband technologies, such as 3G. However, as our focus is on the fixed broadband market, we do not take into account mobile broadband technologies.

[2]An entrant can use any technology when it invests in a network from the outset, without climbing the investment ladder.

[3]Several elements in the architectures of DSL and cable DOCSIS (Data Over Cable Service Interface Specification) networks cause these two broadband access technologies to be incompatible. For example, a DSL access network is based on ATM (Asynchronous Transfer Mode) transmission standards at the layer 2 in the OSI model, whereas a cable network uses Ethernet or IP-based forwarding for connections between the network interface of cable modem termination systems and wider area networks. By contrast, fibre access networks, for instance, are based on ATM transmission standards, and, hence, are compatible with the architecture of DSL networks. Finally, note that the assumption that we make (i.e., to ignore cable as an investment option on the ladder) is in line with the positions of regulators: When they have set up a ladder-of-investment, they never argue that cable is an option for the entrants that climb that ladder.

modem and satellite, Table 3.3 shows that optical fibre and WLL are the two main ladder-compatible access technologies, whereas PLC is hardly used by entrants.

	Fibre (%)	WLL (%)	PLC (%)
Jul. 2002	91.1	6.4	2.5
Jul. 2010	85.3	13.6	1.1

Table 3.3: Share of fibre, WLL and PLC in the EU15 countries (with respect to the total number of fibre, WLL and PLC subscriber lines operated by entrants). Source: EC COCOM reports.

Table 3.2 showed that cable modem—an access technology which is not compatible with the ladder-of-investment—remains the most important alternative broadband technology to DSL over the years. This can be interpreted as weak evidence of the inefficiency of the ladder-of-investment approach. Indeed, even though this approach has been implemented by European NRAs to help new entrants to invest in their own infrastructures, most of the investment has been made by cable operators, which are different players, by upgrading their cable television networks to provide broadband internet services. As the development of cable modem might have an important impact on the efficiency of the ladder-of-investment approach, we will use cable modem as a control variable for a robustness test in Section 3.4.

3.2.2 Literature review

The present paper is related to the economic literature on the relationship between access regulation and investment.[1]

The theoretical literature suggests that there is a trade-off for regulators between setting a low access price to achieve static efficiency and investment incentives. This has been highlighted in asymmetric settings where a vertically-integrated incumbent may face a service-based entrant (e.g., see Bourreau and Doğan [2006], Foros [2004], and Gans and King [2004]), and in symmetric settings where two (or more) network operators have to decide on an investment (e.g., see Gans [2001], Cambini and Valletti [2004], and Valletti and Cambini [2005]). However, to the best of our knowledge, there is no existing theoretical literature in

[1] See Valletti [2003], Guthrie [2006], and Cambini and Jiang [2009] for a survey.

support of the ladder-of-investment hypothesis that access-based competition can favor investment.

Our paper belongs to the empirical literature on the relation between access regulation and investment.[1] A first series of papers studies the impact of access prices on investment in alternative infrastructures. Using US data, Crandall, Ingraham and Singer [2004] find a positive relation between the access price and the ratio of facility-based lines to service-based lines. Waverman *et al.* [2007] use European data over the period 2002-2006 and estimate that a 10% reduction in the price of local loop unbundling causes a 18% fall in subscriber share of alternative infrastructures (including cable). However, these two papers do not test the ladder-of-investment hypothesis, which is the focus of our paper.

Grajek and Röller [2012] analyze the relationship between regulation and investment in the telecoms industry. They study a large data set, at the firm level, which covers 70 fixed-line operators in 20 European countries over a 10-year period, and differentiate incumbents' investments from entrants' investments. The specificity of their paper is that they use a regulatory index (the Plaut index, a former version of the Polynomics index) and account for the possible endogeneity of regulation.

Grajek and Röller find a negative relation between access regulation and individual investments of both incumbents and entrants, despite the fact that total investment by entrants increases. However, they do not test directly the ladder of investment hypothesis, since they cannot distinguish investments in new telecommunications infrastructures from other forms of investment. Our paper studies specifically the number of lines in new infrastructures, and hence, we can provide a more direct test of the ladder-of-investment hypothesis.

Some papers have proposed tests of the ladder-of-investment hypothesis, but mainly qualitatively. Hausman and Sidak [2005] propose a case-based review of the unbundling experience in five countries and find no stylized facts in line with the ladder-of-investment hypothesis. Crandall and Sidak [2007] observe that new entrants seem to be stuck at the lowest rung of the ladder in Mexico. Distaso, Lupi and Manenti [2009] analyze graphically the relation between access prices and the development of alternative broadband infrastructures, and conclude that European national regulatory authorities have adopted policies that are consistent

[1] See Cambini and Jiang [2009] for a survey of this empirical literature.

with the ladder-of-investment approach. Our paper differs from these qualitative studies, as we perform an econometric analysis to test the ladder-of-investment hypothesis.

Closer to our paper, Hazlett and Bazelon [2005] use US data from 1999 to 2004, and study the impact of the share of past UNE-P lines (unbundled network elements platforms) in one period of time on the share of facility-based lines owned by new entrants in later periods. They reject the ladder-of-investment hypothesis. However, their econometric analysis is fragile, since their only control variable is the unemployment rate.

Wallsten and Hausladen [2009] study the impact of the number unbundled and bitstream access lines per capita on investment in next generation access networks in Europe, from July 2002 to July 2007. They find a negative regulation between unbundled lines and investment in fibre access networks, both for entrants' and incumbents' investments. However, they estimate only the contemporaneous effects of local loop unbundling, and hence, they cannot capture the investment dynamics.

3.3 Empirical evidence

In this section we begin by presenting our test of the ladder-of-investment hypothesis. Then, we describe our data and provide the estimation results.

3.3.1 Testing the ladder-of-investment approach

According to the standard view, a regulatory framework that favors service-based entry (e.g., via LLU) introduces an opportunity cost for entrants of investing later on in new lines, due to the profits that the entrants currently enjoy under service-based competition. This effect corresponds to the "replacement effect" that has been introduced in the innovation literature.[1] Due to this opportunity cost, the more favourable are the conditions for service-based entry, the more LLU lines there are, and the less new lines there will be.

On the contrary, the "ladder-of-investment approach" claims that a phase

[1]See Arrow [1962]. A monopolist has less incentive to innovate than does a new entrant, because the former replaces "itself."

of service-based competition fosters facility-based investments by entrants in the long run. The idea is that operating in the market with LLU provides the entrants with market experience, which, in turn, increases their incentives to roll out new lines in the future; one can think of lower costs of investing in new lines (supply side), or a higher demand for new lines because consumers become progressively aware of the entrant's existence (demand side). We refer to this positive effect of service-based competition on investment, via market experience, as the "ladder-of-investment effect."

Therefore, there are two conflicting effects at play when service-based competition develops: the replacement effect emphasized by the standard view, and the ladder-of-investment effect. The "ladder-of-investment hypothesis" is that the ladder-of-investment effect dominates the replacement effect: Overall, a higher number of LLU lines causes a higher number of new lines.

We wish to test the ladder-of-investment hypothesis. Ideally, we would have two different groups of countries: one "treated" group where LLU (here, the treatment) has been implemented, and a "control" group of countries where LLU has not been implemented. We would then test the ladder-of-investment hypothesis by comparing the number of new lines in the "treated group" to that in the "control group," everything else equal. If the number of new lines is greater with the "treatment," the ladder-of-investment hypothesis would be supported.

Unfortunately, all European countries have implemented LLU, since LLU has been mandatory at the European level since a 2000 Regulation. Hence, we cannot conduct this "ideal test." However, some European countries have been more proactive in developing service-based competition than have others, and therefore, LLU is more developed in some countries than in others. If we interpret the development of LLU as the consequence of the intensity of the "treatment" (here, a policy that is conducive to service-based entry), we can test whether in the countries that have received more of the treatment new lines are more developed. That is, we can test whether in countries with a larger number of LLU lines there are more new lines afterwards.

We therefore estimate the impact of the past stock of LLU lines on the stock of new lines with the following model:

$$\log(Newlines)_{i,t} = \beta_0 + \beta_1 \log(Newlines)_{i,t-1} + \beta_2 \log(LLUlines)_{i,t-2} \\ + \beta_x controls_{i,t} + \varepsilon_i + \eta_t + u_{i,t}, \tag{3.1}$$

where $Newlines_{i,t}$ denotes the number (stock) of entrants' broadband lines in country i and semester t that are based on fibre, WLL, or PLC access technologies;[1] $LLUlines_{i,t}$ is the number (stock) of entrants' lines that are based on local loop unbundling, and *controls* is a set of control variables that account for the changes in demand and costs of telecommunication services. Since broadband penetration may depend heavily on specific demand or institutional factors that can vary throughout the period, we also include country fixed effects (ε_i) and time fixed effects (η_t).

As entrants decide on the increment of investment, not on the total stock of investment, we control for the level of new lines that are owned by entrants in the previous period, $Newlines_{i,t-1}$. Besides, if entrants invest in LLU lines and then switch later to new lines, we expect to see a reduction in the investment in $LLUlines$ just before the investment takes place. Therefore, we use the $t-2$ lag for the number of $LLUlines$, instead of the $t-1$ lag.[2]

We wish to test the ladder-of-investment hypothesis, according to which service-based competition acts as a stepping stone to facility-based entry. To test this hypothesis, we evaluate whether, overall, more service-based entry leads to more facility-based entry later on; that is, whether $\beta_2 > 0$.

3.3.2 The data

Most of our data are extracted from the annual European Commission's "Broadband access in the EU" reports, and cover 15 European countries over the period July 2002-July 2010, on a semi-annual basis. The data allow us to distinguish between incumbents' and entrants' lines, but we do not have the number of lines at the entrant firm level.[3] Besides, some values are missing for France (semesters

[1]WLL stands for Wireless Local Loop, and PLC stands for Power Line Communications. As we explained in Section 3.2, we exclude cable lines and satellite connections.

[2]We tested our model with additional lags for $LLUlines$, and obtained similar results.

[3]We also do not have any information on the number of entrants per country.

15, 16, and 17), Finland (semester 15), Ireland (semester 17), the Netherlands (semester 17), and the United-Kingdom (semester 17). Hence, the dataset, which is composed of 248 observations over 17 semesters, is a slightly unbalanced panel with randomly missing data. However, due to the very low number of randomly missing observations, we can consider our dataset as a balanced set.

3.3.2.1 Main variables

The main variables that are used in the main analysis are the following (see also Table 3.8 in Appendix 3.6 for summary statistics):[1]

- $\log(Newlines)$ represents the number of broadband lines that belong to new entrants and that are neither DSL- nor cable-based, but are deployed using a new access technology (fibre, WLL, or PLC), in logarithms.[2]

- $\log(LLUlines)$ represents the number of unbundled lines that are operated by new entrants via full local loop unbundling (LLU) or shared LLU, in logarithms.

- $\log(BAlines)$ represents the number of bitstream access (BA) lines that are used by new entrants to deliver broadband services, in logarithms.

- The control variable *incmob* represents the market share of the incumbent in the mobile telephony market.[3] This variable is used as a proxy for the incumbent's market power in telecommunications markets.[4] Indeed, an incumbent operator with market power might try to retard entrants' investment in alternative access infrastructure, resulting in a low number of new lines for entrants.[5]

[1] In Section 3.4, we will introduce additional variables to conduct some robustness checks.

[2] As the variables that represent a number of subscribers (i.e., $Newlines$, $LLUlines$, and $BAlines$) can take values of zero, $\log(Newlines)$ is actually computed as $\log(Newlines + 1)$.

[3] Note that the British incumbent operator did not own any mobile operations for the period under study. Similarly, the Irish incumbent sold its mobile operations in 2001 and re-entered the mobile market in 2005 through an acquisition.

[4] We also tried to use other variables to control for market power, and in particular the Hirschmann-Herfindahl index (HHI) for the broadband market. Our results remained unchanged. Note however that the HHI for the broadband market could be an endogenous variable.

[5] See Bourreau and Doğan [2006] for a theoretical argument along this line.

- We use as control variables for changes in demand for broadband services the half-year gross domestic product (GDP) per capita in constant euros in logarithm, $\log(GDPpercapita)$, the country population in logarithm, $\log(Pop)$, and the mobile penetration rate, *mobpenrate*.[1]

- Finally, the population density in a given country, *density*, is included to control for changes in the cost of building a network.[2] Indeed, it costs less to build an access infrastructure in an area with a higher density of population.[3]

3.3.2.2 Time series plots

Time-series plots for the complete ladder, with $Newlines$, $LLUlines$, and $Cablelines$ operated by entrants, for each country, are reported in Figure 3.2 in Appendix 3.6.[4]

[1]Source for the GDP per capita: OECD. For population: OECD (except for France, source: INSEE; see the footnote on Table 3.8 in Appendix 3.6). For mobile penetration: ICT Eye - ITU.

[2]Source: OECD Factbook 2009 for population (except for France, source: INSEE), and Eurostat for the size of the country (except for France, source: CIA World Factbook).

[3]Due to lack of appropriate data, we cannot control directly for the cost of fibre. However, we believe that our analysis does not suffer from a huge omitted variable problem. Indeed, the cost of a fibre infrastructure in a given country typically depends on the cost of fibre equipment and on factors that determine infrastructure costs in that country. The cost of fibre equipment (fibre cables, optical routers, etc.) is roughly the same in all European countries, and therefore is captured through the time fixed effects in our estimations. As for factors that affect infrastructure costs, we control for population density in each country (which is often used as a proxy for infrastructure costs). Finally, note that the cost of a fibre network is not huge, relative to the cost of a mobile network. For example, in France, it would cost between 5 and 10 billion Euros to build a national mobile network, and 8-10 billion Euros to cover 60-70% of France with fibre (DATAR [2010]; Maurey [2002]).

[4]The specific patterns that we observe for Denmark, the Netherlands, and Portugal can be explained by some industry facts that are unrelated to the ladder-of-investment. First, we observe a fast decrease in the number of LLU lines in Denmark (in 2009) and in the Netherlands (in 2007), followed by a growth in LLU lines. In both countries, the decrease in the number of LLU lines is explained by the acquisition of an entrant by the incumbent operator. Second, in Portugal, we observe an important increase in cable lines followed by a decrease in LLU lines and a take-up in new access lines. This is explained by the fact that, in 2007, the incumbent, which owned at that time a local copper network and a cable network, had to sell its entire cable activity to competitors. This justifies the important increase in cable lines that are controlled by entrants. At that time, therefore, facility-based competition between cable and the incumbent's copper network suddenly emerged. As a response, LLU entrants either exited the market or started to replace their LLU-based offers by investing in new lines in order to remain competitive.

On most plots, we observe a continuous growth in $LLUlines$, whereas the number of $Newlines$ remains small and relatively stable. Therefore, we do not observe any clear evidence for the ladder-of-investment hypothesis; that is, there is no (overall) positive relation between the number of past LLU lines and the number of new lines.

Three countries do not follow this general pattern: Denmark, Ireland, and Sweden. In these countries, we observe a growth in $LLUlines$ as well as a growth in $Newlines$. Nevertheless, we do not believe that this provides evidence for the ladder-of-investment hypothesis, mainly because these countries have well-developed cable infrastructures, and, therefore, inter-platform competition (between DSL and cable infrastructures) might drive investment in $Newlines$.[1,2]

3.3.3 Estimation results

We estimate our results using the linear generalized method of moments (GMM) (see Arellano and Bond [1991], Arellano and Bover [1995], and Blundell and Bond [1998]), notably because our dependent variable ($Newlines_{i,t}$) is dynamic, and, therefore, we suspect the presence of autocorrelation within individuals and of heteroskedasticity. Moreover, our independent variables are not strictly exogenous. The GMM allows us to use internal instruments, which are all lags of the instrumented variable and of external instruments.[3]

Following Bond [2002], we use the difference-GMM estimator, rather than the system-GMM estimator, because there is little persistence in our model, and we want to keep a small number of instruments. The difference-GMM estimator transforms all regressors by differencing them, and uses the Generalized Method of Moments to estimate the coefficients. Hence, we can interpret the coefficient β_2 in model (1) as the effect of the number of unbundled lines on the number of

[1] In Section 3.4, we will take cable into account as a robustness check.

[2] Moreover, in Ireland, the growth in $LLUlines$ starts after the growth in $Newlines$ has already begun. This is not consistent with the ladder-of-investment hypothesis, which claims that the development of LLU fosters investment in $Newlines$.

[3] The OLS and IV estimation results are reported in Table 3.9 in Appendix 3.6. We first run an OLS estimation. We find that the coefficient of $log(LLUlines)_{t-2}$ is not statistically different from zero. Hence, we find no evidence of a ladder of investment effect with this OLS estimation. Similar to the OLS estimation, we find no statistically significant effect of the number of local loop unbundling lines on investment in new access lines for the IV estimation: the coefficient $log(LLUlines)_{t-2}$ is still not statistically significant.

new lines, or the impact of the increase in unbundled lines on the increase in the number of new lines.

As we suspect $LLUlines$ to be endogenous, we instrument this variable with $BAlines$.[1] Indeed, if we follow a strict rung-by-rung ladder-of-investment approach, we can consider that the number of unbundled lines ($LLUlines$) depends on the number of past bitstream access lines ($BAlines$).[2]

We consider the number of bitstream access lines to be the best instrument.[3] Indeed, entrant operators do not switch directly from bitstream access to their own access infrastructure, so $BAlines$ does not directly impact $Newlines$. If an entrant operates at the bitstream access level and plans to invest in its own new lines, it would typically start by investing in local loop unbundling. This investment pattern corresponds to the "step-by-step" approach of the ladder-of-investment that has been proposed by Cave [2006]. The underlying reason is that investing in an access network (the new lines) means investing in the "last mile" of a telecommunications network. Before rolling out its access network infrastructure, an entrant has to reach this last mile—and this is what local loop unbundling typically allows for.[4]

[1] In the difference-GMM, the instrumental variables are therefore (i) the number of $BAlines$, (ii) all lags of $Newlines$ (starting from the 1-period lag), and (iii) all lags of $LLUlines$ (starting from the 2-period lag).

[2] We also ran OLS and IV regressions (the estimation results are available upon request from the authors), and performed a Hausman test to compare the estimates and to determine whether the difference in coefficients was statistically significant. In a first stage, we regressed $\log(LLUlines)$ on all exogenous variables, including the lagged values of $\log(BAlines)$, and predicted the residuals. In a second step, we regressed $\log(Newlines)$ on $\log(LLUlines)$, other exogenous variables (excluding $\log(BAlines)$), and the residuals of the first-stage estimation. The Hausman test is equivalent to a t-test on the coefficient of the residuals. The coefficient of the residuals was equal to -0.546 and the t-test was equal to -2.75; hence, we rejected the hypothesis at the 1% level. We can conclude that $\log(LLUlines)$ is not exogenous.

[3] As a robustness check, we considered an alternative and more extensive instrument, which is the sum of service-based lines that were opened through bitstream access and resale. Indeed, it could be argued that new entrants could earn some market experience through resale, and then climb directly to the LLU rung. When we use this more extensive instrument, our results are not affected. However, we consider that the number of bitstream access lines represents the best instrument for the number of unbundled lines, as we follow the rung-by-rung approach of the ladder-of-investment.

[4] Telecommunications operators confirmed to us that this was the usual investment pattern that is observed in Europe. We also found some empirical evidence that this is indeed the pattern in France. In this country, the main entrant investing in fibre (excluding the cable network operator) is the company SFR. From SFR's website, we found the cities where SFR has invested in fibre (as of November, 2011). For all of these cities, we then checked whether SFR was using local loop unbundling, or bitstream access. We found that it was using LLU

Finally, there is no endogeneity problem concerning our control variables, as $\log(Pop)$, *density*, or $\log(GDPpercapita)$ are most likely not correlated with elements in the error terms that would determine simultaneously $\log(Newlines)$.[1] Moreover, *incmob* and *mobpenrate* are control variables that relate to the mobile telephony market, and the development of the mobile telephony and fixed broadband markets can be considered as independent during the time period of our study.[2]

Our estimation results are reported in Table 3.4. We find that the coefficient of $\log(LLUlines)_{t-2}$ is not statistically different from zero. Hence, we reject the ladder hypothesis at the 10% level.

Regarding the different tests that are performed in our estimation, first note that we did not introduce country fixed effects in the GMM estimations, since the first differences performed under the GMM would eliminate them. Besides, we kept time fixed effects because they were sometimes individually significant, even if they did not pass the F-test for collective significance. We report the autoregressive tests AR(1) and AR(2) for the null hypothesis of no first —or second— order serial correlation, respectively. We observe that the residuals in first differences (AR(1)) are correlated, but there is no serial correlation in second differences (AR(2)). Finally, the Hansen parameter tests for over-identification.[3]

in all of them and BA in none of them. In other words, we do not observe any switch from bitstream access to fibre for SFR, whereas SFR uses bitstream access (and not LLU) in a significant proportion of French cities.

[1]We use $\log(Pop)$ as a control variable, but we do not address the question of the partial effect of population on new lines. The correlation between some of the explanatory variables could lead to a high variance in the coefficient of $\log(Pop)$. Some of the independent variables (e.g., $\log(Pop)$ and $\log(GPDpercapita)$) are highly correlated; hence one cannot interpret the partial effect of each of them, though they are collectively significant.

[2]However, with the development of smartphones, it might be that factors that influence the penetration of mobile phones also affect the demand for broadband services. As a robustness check, we therefore ran our estimations for the period before the launch of the first iPhone in Europe (2002-2007). Our qualitative results were not modified.

[3]Note that this test is not robust to a large number of instruments, and always equals one, thus making us suspect the presence of an excessive number of instruments. We used the "collapse" option in xtabond2 (Stata) in order to reduce the number of instruments. As a robustness check, we also reduced the number of lags and dropped time dummy variables. In these alternative estimations, the Hansen parameter has a p-value ranging between 0.9 and 1. Hence, we cannot reject the hypothesis that our instruments are valid.

3.3.4 An alternative specification: a short ladder-of-investment

Cave [2006] argues that with a ladder-of-investment in place, entrants will progressively climb up to the last replicable rung. This last replicable rung can be the local loop, in which case entrants end up building their own facilities, which results in a pure form of facility-based competition. The last replicable rung could also be at a lower level —for example at the local exchange level, in which case entrants still rely on the incumbent's network (see Cave [2010]). We refer to this restricted form of ladder as the *short ladder*.

In the previous subsections, we tested the ladder of investment hypothesis for the complete ladder, which is composed of three rungs: bitstream access, local loop unbundling, and new lines.[1] The short ladder is composed of only two rungs: bitstream access and local loop unbundling. Note that at the last rung of the short ladder (i.e., local loop unbundling), the entrants still rely on the incumbent's infrastructure (i.e., the local loop) to provide their services.

3.3.4.1 Time series plots for the short ladder

As for the complete ladder, we provide time series plots for the short ladder in Figure 3.3 in Appendix 3.6, with the number of $LLUlines$ and $BAlines$ that are operated by entrants in each EU15 country.

We observe three main patterns across European countries: The first pattern is characterized by a continuous growth in $LLUlines$, while the number of bitstream access lines remains small and stable, in which case there is no clear correlation between investment in $LLUlines$ and investment in $BAlines$. This pattern is observed in Germany, Luxembourg, the Netherlands, and Sweden.

The second pattern is characterized by a fast take-up of bitstream access lines. In Austria, Greece, Italy, Portugal, Spain, and the United-Kingdom, the development of bitstream access may have acted as a starting point for competition, and it was followed by important investments at the LLU level. This suggests that a ladder-of-investment effect might have been operational between bitstream access and LLU in these countries. By contrast, in Belgium and Ireland, we ob-

[1] We could also consider a four-rung ladder that is composed of resale, bitstream access, local loop unbundling, and new lines. However, adding resale lines does not modify our results. Besides, the number of bitstream access lines is not determined by the number of resale lines, since new entrants can enter directly at the bitstream access rung.

serve a fast take-up of bitstream access, but only a small subsequent growth in the number of $LLUlines$. For these two countries, there seems to be only a weak correlation between investment in $LLUlines$ and investment in $BAlines$.

Finally, in Denmark, Finland, and France, we observe a third pattern: A steady growth in $LLUlines$, which seems to accelerate just after the development of bitstream access. This seems also consistent with the ladder-of-investment hypothesis for the short ladder.

3.3.4.2 The ladder-of-investment hypothesis for the short ladder

We estimate the following model for the short ladder, which is similar to our main model (3.1):

$$\begin{aligned}\log(LLUlines)_{i,t} = \beta_0' + \beta_1' \log(LLUlines)_{i,t-1} + \beta_2' \log(BAlines)_{i,t-2} \\ + \beta_x' controls_{i,t} + \varepsilon_i + \eta_t + u_{i,t}.\end{aligned} \tag{3.2}$$

For the same reasons as in the previous subsection, we use the difference-GMM estimator.[1] The estimation results are reproduced in Table 3.4. In the short-ladder regression, time fixed effects do not pass the F-test for collective significance and are not individually significant; so we do not keep them in this regression.[2]

Contrary to our results for the complete ladder, for the short ladder we observe that the development of $BAlines$ favors the development of $LLUlines$ afterwards. Indeed, the coefficient of $\log(BAlines)_{t-2}$ is positive and significant at the 10% level. In other words, according to our estimation, an increase of bitstream access lines leads to an increase of local loop unbundling lines one year later. We

[1]The system GMM estimates give a non-significant coefficient for $\log(BAlines)$. The system GMM estimator makes an additional assumption that can be tested using a difference-in-Hansen test of exogeneity. The difference-in-Hansen test checks the over-identification of the additional instruments of the level equation. This test equals one in the case of too many instruments. When we try to reduce the number of instruments (by reducing lags, or by using the collapse option in Stata), the difference-in-Hansen test gives a small p-value. Hence, we reject the hypothesis that the additional subset of instruments that are used in the system GMM estimation are exogenous. Thus, we keep the difference GMM estimation.

[2]The institutional context may explain this result: The European Regulation 2887/2000 on unbundled access to the local loop imposed mandatory LLU for all member states. Hence, once a European country has transposed the European regulation, we expect no specific time effect: The time path of the number of unbundled lines in each country has no reason to vary significantly.

	Complete Ladder	Short Ladder
	GMM-Diff	GMM-Diff
	$\log(Newlines)_t$	$\log(LLUlines)_t$
$\log(Newlines)_{t-1}$	0.552***	
	(3.78)	
$\log(LLUlines)_{t-1}$		0.613***
		(4.80)
$\log(LLUlines)_{t-2}$	-0.0931	
	(-0.91)	
$\log(BAlines)_{t-2}$		0.0515*
		(2.10)
$incmob_t$	-0.489	1.453
	(-0.26)	(1.03)
$\log(GDPpercapita)_t$	-1.802	0.220
	(-0.76)	(0.38)
$mobpenrate_t$	-0.00549	0.0126
	(-0.31)	(1.72)
$density_t$	0.0484	0.0602
	(0.63)	(1.46)
$\log(Pop)_t$	8.817	-4.637
	(0.60)	(-0.58)
N	171	207
$Arellano-Bond\ test\ AR(1)$	-2.08	-2.12
$(p-value)$	(0.038)	(0.034)
$Arellano-Bond\ test\ AR(2)$	-0.30	-1.17
$(p-value)$	(0.761)	(0.242)
$Hansen\ J-test\ (p-value)$	(1.000)	(1.000)
$F-test\ (time)$	3.90	
$(p-value)$	(0.0089)	

Notes: t-statistics in parenthesis. Statistical significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Instrumented variable: $\log(LLUlines)_{t-2}$, Instrument variable: $\log(BAlines)_{t-4}$.
Time fixed effects included in the complete ladder specification.

Table 3.4: Main results

therefore find an empirical support for the ladder-of-investment hypothesis for the short ladder.

To sum up, we found no support for the ladder-of-investment hypothesis for the complete ladder, but some support for the short ladder between $BAlines$ and $LLUlines$. Hence, new entrants climb the ladder up to the local loop unbundling rung; but being on the ladder does not increase their incentives to build a last-mile network.

3.4 Robustness

In this section we perform some additional estimations in order to test the robustness of our findings, both for the complete and short ladders, with respect to the "migration effect," the number of rungs, the development of cable modem, regulatory performance, and the evolution of local loop unbundling prices (see Table 3.8 in Appendix 3.6 for the summary statistics of the additional variables that we use in this section).

3.4.1 Taking into account the migration effect

The estimate of β_2 in model (3.1) may be biased downward due to what we call the "migration effect": Some consumers may indeed switch from a $LLUline$ subscription that is provided by an entrant to a $Newline$ subscription that is provided by the same or another entrant. This consumer switching induces a migration (or waterbed) effect: The stock of LLU lines goes down, while the stock of new lines goes up, which generates a negative relationship between $LLUlines$ and $Newlines$. One concern is then that, though the ladder hypothesis would be valid, we could observe a negative relationship (i.e., $\beta_2 < 0$) or no significant relationship, due to the negative migration effect.

Note that the migration effect is limited to a certain type of consumers. Indeed, this effect only exists for consumers who switch from one of the entrants' LLU-based offers to one of their new lines offers. By contrast, it does not concern new consumers who were not served at all in the previous period, nor those who were served by the incumbent or by competitors using other broadband technologies (e.g., cable). Moreover, the broadband market is a growing market, and we observe an increasing number of LLU lines over time in the time-series plots, which mitigates the migration effect. Actually, in the plots we do not observe a strong decrease in the number of $LLUlines$ that are linked to an increase in the number of $Newlines$.

One solution to eliminate or mitigate the migration effect is to take a first difference for the number of $Newlines$ on the left-hand-side of model (3.1). The intuition is that the migration effect is driven by the fact that there is a transfer of a stock of lines from LLU to $Newlines$. By taking into account the variation of $Newlines$ instead of the stock, we eliminate this transferred stock, and hence, we also eliminate or mitigate the migration effect.

Therefore, in order to test the robustness of our results to the migration effect, we modified model (3.1) as follows:

$$\begin{aligned}\Delta(\log(Newlines))_{i,t} = \beta_0 + \beta_1 \log(Newlines)_{i,t-2} + \beta_2 \log(LLUlines)_{i,t-2} \\ + \beta_x controls_{i,t} + \varepsilon_i + \eta_t + u_{i,t}.\end{aligned} \tag{3.3}$$

In model (3.3), we estimate the impact of the stock of LLU lines on the flow of new lines. As for model (3.1), we use the stock of $Newlines$ at period $t-2$ as a RHS variable, in order to correct for dynamic effects due to the diffusion of $Newlines$. We also implemented the same modifications to model (3.2) for the short ladder.

The estimation results are reported in Table 3.5 below. We find no evidence in support of the ladder-of-investment hypothesis; that is, no significant positive effect of past $LLUlines$ on the flow of $Newlines$ for the complete ladder. By contrast, we observe a positive impact of past $BAlines$ on the flow of $LLUlines$, at the 10% level, which indicates a weak evidence for the ladder-of-investment hypothesis for the short ladder. Therefore, our results and conclusion seem robust to the migration effect.

Note that we also observe a negative impact of the level of past $Newlines$ on the flow of $Newlines$, showing that the growth in $Newlines$ is concave. We observe the same pattern for the short ladder and the growth in $LLUlines$.

	Complete Ladder	**Short Ladder**
	GMM-Diff	GMM-Diff
	$\Delta \log(Newlines)_t$	$\Delta \log(LLUlines)_t$
$\log(Newlines)_{t-2}$	-0.262***	
	(-4.49)	
$\log(LLUlines)_{t-2}$	-0.188	-0.211***
	(-1.61)	(-6.13)
$\log(BAlines)_{t-2}$		0.0319*
		(1.85)
$incmob_t$	0.876	2.221
	(0.56)	(1.69)
$\log(GDPpercapita)_t$	-1.161	0.00170
	(-0.51)	(0.00)
$mobpenrate_t$	-0.00184	0.000989
	(-0.12)	(0.21)
$density_t$	-0.00835	0.0509
	(-0.15)	(0.96)
$\log(Pop)_t$	11.68	-12.61
	(0.89)	(-0.84)
N	171	207
$Arellano-Bond\ test\ AR(1)$	-2.41	-1.52
$(p-value)$	(0.016)	(0.129)
$Arellano-Bond\ test\ AR(2)$	0.74	-0.98
$(p-value)$	(0.461)	(0.329)
$Hansen\ J-test\ (p-value)$	(1.000)	(1.000)
$F-test\ (time)$	49.86	65.09
$(p-value)$	(0.0000)	(0.0000)

Notes: t-statistics in parenthesis. Statistical significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Instrumented variable: $\log(LLUlines)_{t-2}$, Instrument variable: $\log(BAlines)_{t-4}$.
Time fixed effects included in both specifications.

Table 3.5: Main results for the first-difference model

3.4.2 Controlling for the number of rungs

According to the analysis of the ladder-of-investment approach by the European Regulators Group (ERG [2005]), we should expect a positive effect of the number of levels of access on the number of facility-based lines.[1] There are two arguments for requiring access at multiple levels. First, new entrants might have different business models (for example, there might be both pure service-based entrants and entrants with investment plans). Second, the optimal level of access might differ according to the geographical area.

To control for the number of rungs, we introduce the variable *access*, which is the sum of three dummy variables. Each dummy variable in this sum represents a given level of access (local loop unbundling, bitstream access, and resale), and it is equal to 1 if the number of lines through this type of access represents more than 7% of the total number of DSL lines in a given country at a given period of time, and to 0 otherwise.[2]

Introducing the variable *access* does not affect our main result. Besides, it has no effect on the number of new lines rolled out by new entrants (see Table 3.6).

3.4.3 Controlling for cable

Cable modem is a technology that uses cable television lines to provide broadband services. We test whether our results remain valid if we account for the development of cable modem.[3]

As there are huge disparities between European countries in broadband cable lines, we create a dummy variable, *Cable*, which classifies countries into two groups according to the development of broadband cable modem lines. The variable *Cable* equals one if the country is above the median in cable modem use, and to zero otherwise.[4]

[1] For example, ERG [2005] writes that "the complementary use of several access products may mean that both forms of access should be made available over a longer period."

[2] We also performed our analysis with other threshold values for each type of access, ranging from 5% to 15% of DSL lines. The qualitative results remained the same.

[3] Cardona *et al.* [2009] provide some empirical evidence that DSL and cable networks are indeed part of the same market.

[4] We performed the same test using a mean split, and obtained similar results.

With the *Cable* dummy variable, we are able to separate our dataset in two subsamples (countries with low and high penetration of cable). This allows us to estimate all coefficients for the two subsamples. From a theory viewpoint, we could indeed expect the development of cable to affect not only the number of *Newlines per se*, but also the relation between our other control variables and entrants' investments.[1]

The estimation results for the difference-GMM regressions for both subsamples are reproduced in Table 3.6. Our main conclusion remains valid: We still reject the ladder-of-investment hypothesis at the 10% level. Interestingly, in countries with a high penetration of cable, our GMM estimation indicates that the number of LLU lines affects negatively and significantly the number of new lines that are owned by entrants. This suggests that the ladder-of-investment approach may be less effective when there is strong inter-platform competition (i.e., between the DSL and cable platforms).

Finally, we find no evidence for the ladder-of-investment hypothesis for the short ladder in low-cable countries. This means that in countries where the competition from cable networks is limited, bitstream access does not act as a stepping stone for entrants' investment in local loop unbundled lines.

3.4.4 Controlling for the quality of the implementation of the ladder

One could argue that, if we do not find any evidence for the ladder of investment hypothesis (i.e., no positive relation between the number of access lines and the number of infrastructure lines owned by entrants), this might be because the ladder-of-investment approach has been imperfectly implemented on average. If we assume that a more "efficient" regulator could implement a more "effective" ladder-of-investment, the intensity of regulation might affect the relation between service-based competition and facility-based competition. That is, we might expect a more positive relation for more "efficient" regulators.

[1]We also ran an estimation using the cable market share as a level variable. This did not qualitatively affect our results.

	Rungs		Cable: country split			
	Complete ladder	Short ladder	Complete ladder		Short ladder	
			Low	High	Low	High
	GMM-Diff	GMM-Diff	GMM-Diff	GMM-Diff	GMM-Diff	GMM-Diff
	$\log(Newlines)_t$	$\log(LLUlines)_t$	$\log(Newlines)_t$	$\log(Newlines)_t$	$\log(LLUlines)_t$	$\log(LLUlines)_t$
$\log(Newlines)_{t-1}$	0.555***		0.553	0.341*		
	(3.88)		(1.06)	(2.33)		
$\log(LLUlines)_{t-1}$		0.611***			0.779***	0.541***
		(4.61)			(14.27)	(3.08)
$\log(LLUlines)_{t-2}$	-0.0876		0.144	-0.343**		
	(-0.86)		(0.78)	(-2.55)		
$\log(BAlines)_{t-2}$		0.0501*			-0.00198	0.105*
		(2.09)			(-0.19)	(2.35)
$access_{t-2}$	-0.118	0.0283				
	(-0.64)	(0.35)				
$incmob_t$	-0.473	1.494	-3.786	-13.77**	2.316	0.398
	(-0.26)	(1.07)	(-0.71)	(-3.02)	(1.86)	(0.19)
$\log(GDPpercapita)_t$	-1.874	0.229	-4.868	-3.983**	2.361*	-1.148
	(-0.79)	(0.39)	(-0.44)	(-2.42)	(1.99)	(-1.23)
$mobpenrate_t$	-0.00574	0.0125	0.00937	0.0157	0.0101*	0.0162
	(-0.32)	(1.73)	(0.22)	(0.88)	(1.96)	(1.66)
$density_t$	0.0634	0.0562	-0.207	0.172**	0.00427	-0.00576
	(0.70)	(1.33)	(-0.72)	(2.62)	(0.21)	(-0.14)
$\log(Pop)_t$	6.953	-4.597	44.60	-19.49	-5.264	-8.611
	(0.55)	(-0.57)	(0.96)	(-1.63)	(-0.96)	(0.58)
N	171	207	77	94	98	109
$Arellano-Bond\ test\ AR(1)$	-2.08	-2.01	-1.63	-1.83	-1.45	-1.76
$(p-value)$	(0.037)	(0.045)	(0.103)	(0.068)	(0.146)	(0.078)
$Arellano-Bond\ test\ AR(2)$	-0.40	-1.19	0.22	-0.21	-1.00	-0.28
$(p-value)$	(0.687)	(0.235)	(0.823)	(0.836)	(0.316)	(0.780)
$Hansen\ J-test\ (p-value)$	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
$F-test\ (time)$	5.99		0.99	3.16		
$(p-value)$	(0.0011)		(0.5035)	(0.0759)		

Notes: t-statistics in parenthesis. Statistical significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Instrumented variable: $\log(LLUlines)_{t-2}$, Instrument variable: $\log(BAlines)_{t-4}$. Time fixed effects included in the complete ladder specifications. "Low Cable" and "High Cable" countries distinguished by *Cable* dummy variable. "Low Cable" countries: Finland, France, Germany, Greece, Ireland, Italy, Luxembourg. "High Cable" countries: Austria, Belgium, Denmark the Netherlands, Portugal, Spain, Sweden, United-Kingdom.

Table 3.6: Robustness specifications (1): Rungs and Cable

3.4.4.1 The effect of regulatory intensity

To control for regulatory intensity, we add the variable *Polynomics*, which is a telecommunications regulation index that has been constructed by Polynomics (see Zenhäusen *et al.* [2012]).[1] A higher value of the index is associated with a higher regulatory intensity or density.[2] Since the Polynomics index is available on an annual basis for the period 1997-2010, our dataset is reduced to an annual dataset, in which one period corresponds to two periods in the previous semi-annual dataset.

We use the *Polynomics* variable as an interaction term for our main explanatory variable. Indeed, we wish to test whether a more intense regulator (i.e., with a higher index value) leads to a more positive relation between access and investment. When we include the joint variable $Polynomics \times \log(LLUlines)$ to our list of explanatory variables, we find no significant effect of regulatory performance.[3] Our results regarding the complete ladder remain unchanged, and we find no evidence for the ladder-of-investment hypothesis for the short ladder.

3.4.4.2 The effect of local loop unbundling prices

Another way to account for the effectiveness of the implementation of the ladder-of-investment is to use the evolution of the price of local loop unbundling. Indeed, according to the ladder of investment approach, the regulator should increase the price of LLU to incentivize the entrants to invest in their own access networks.

Therefore, in countries where the LLU price goes up, we expect more investment in new lines, and hence, a more positive relation between service-based

[1] We built the Polynomics index from the Polynomics Regulation Index 2012 Dataset, following the tutorial by Zenhäusen *et al.* [2012]. As is true for all regulatory indexes, the Polynomics index has weaknesses; and in particular, it captures only formal aspects of regulation. Thus, it should be interpreted with some caution. However, a previous version of this index (the Plaut Economics index; see Zenhäusen *et al.* [2007]) has been used as a measure of regulatory intensity in other studies (for example, by Grajek and Röller [2012]), and we therefore use it for our robustness check.

[2] That is, the Polynomics index aims at measuring *how much* regulation is implemented (e.g., the number of regulatory remedies), not whether it is effective, which can be done by linking regulatory density to market outcomes.

[3] The estimation results are reproduced in Table 3.7. Note that each period t still represents a semester, but since the Polynomics index is available on an annual basis only, our database for the Polynomics regression is on an annual basis too. Therefore, for example, we lag the $Newlines$ variable 2 periods rather than 1 period.

competition and investments in new lines.

We use data on the monthly fee for LLU from the European Commission Implementation Reports,[1] for eight years (2002-2009), on an annual basis. The theory suggests that an increase of the LLU monthly fee increases the entrants' incentives to build their own facilities. However, since we observe only 15 LLU price increases compared to 90 LLU price decreases over the period, this test is not easy to perform.

Hence, for each period, we compute the average evolution of prices across all of the countries in our sample. In a given country, at a specific period, if the LLU price decreases less than does the cross-country average, we consider that the regulator in this country is enforcing the ladder approach relatively more.

To implement our test, we introduce the dummy variable δ, which classifies countries into two groups according to whether the increase in the LLU monthly fee is higher or lower than average.[2] In other words, for each country i, we have $\delta_{i,t} = 1$ if the price increase of LLU is higher than the average; that is, if $P(LLU)_{i,t} - P(LLU)_{i,t-2} \geqslant \frac{1}{15}\sum_{j=1}^{15}[P(LLU)_{j,t} - P(LLU)_{j,t-2}]$, where $P(LLU)_{i,t}$ denotes the monthly fee for local loop unbundling in constant euros that an entrant has to pay in country i at semester t. We have $\delta_{i,t} = 0$ otherwise.

We use this dummy variable as an interaction term for $LLUlines$. Since we expect that there is a lag between the date at which the fee becomes relatively higher and the date at which an entrant starts to invest, we estimate the impact of a relative monthly fee increase on $\log(Newlines)$ two periods afterwards (which corresponds to one year).

The estimation results are provided in Table 3.7. With this interaction term, we still find no significant and positive impact of unbundled lines on investment in alternative infrastructures by entrants.

[1]European Commission Implementation Reports No. 8, 9, 10, 12, 14, and 15.

[2]We also tested a simplified specification by using a dummy variable that equals one if the LLU monthly fee increases. However, prices could decrease not only because the regulator applies the ladder-of-investment approach, but also for other macroeconomic reasons. Using the shift in prices in a specific country relative to the average allows us to take into account those unobserved factors.

	Polynomics		**LLU Tariffs**
	Complete Ladder	**Short Ladder**	**Complete Ladder**
	GMM-Diff	GMM-Diff	GMM-Diff
	$\log(Newlines)_t$	$\log(LLUlines)_t$	$\log(Newlines)_t$
$\log(Newlines)_{t-2}$	0.368***		0.381**
	(3.48)		(2.59)
$\log(LLUlines)_{t-2}$	0.0676	0.408***	
	(0.40)	(4.23)	
$\log(BAlines)_{t-2}$		-0.0609	
		(-0.78)	
$Polynomics_{t-2} \times \log(LLUlines)_{t-2}$	0.0508		
	(0.23)		
$Polynomics_{t-2} \times \log(BAlines)_{t-2}$		0.226	
		(1.53)	
$\delta_{t-2} \times \log(LLUlines)_{t-2}$			-0.0208
			(-0.99)
$incmob_t$	-0.391	1.342	0.322
	(0.16)	(0.59)	(0.12)
$\log(GDPpercapita)_t$	-1.660	-0.276	-2.651
	(-0.93)	(-0.35)	(-1.14)
$mobpenrate_t$	-0.00884	0.0202**	-0.00452
	(-0.44)	(2.55)	(-0.25)
$density_t$	0.0952	0.00453	0.103
	(0.83)	(0.06)	(0.76)
$\log(Pop)_t$	4.801	0.738	0.281
	(0.26)	(0.05)	(0.01)
N	83	105	83
$Arellano-Bond\ test\ AR(2)$	-1.70	-2.00	-1.36
$(p-value)$	(0.089)	(0.046)	(0.175)
$Hansen\ J-test\ (p-value)$	(1.000)	(1.000)	(1.000)
$F-test\ (time)$	1.46		1.40
$(p-value)$	(0.2629)		(0.2813)

Notes: t-statistics in parenthesis. Statistical significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Instrumented variable: $\log(LLUlines)_{t-2}$, Instrument variable: $\log(BAlines)_{t-4}$. Time fixed effects included in the complete ladder specifications.

Table 3.7: Robustness specifications (2): Polynomics and LLU Tariffs (annual data)

3.4.5 Other robustness checks

As another robustness check, we split our sample in half by time periods, and reran our regressions.[1] For the complete ladder specification, we observe an overall negative effect of past $LLUlines$ on $Newlines$ for the first half of the sample. This suggests that, from 2002 to 2006, investments in Local Loop Unbundling had a negative impact on investment in Next Generation Access Networks. However, we observe no significant effect for the second half of the sample. All in all, this robustness check confirms our main qualitative result, that is, that there is no empirical evidence for the ladder-of-investment hypothesis for the complete ladder.

Finally, we ran our main regressions with $Newlines$, $LLUlines$, and $BAlines$ expressed as the shares of lines over the total number of broadband lines, and alternatively as per country GDP. We found no evidence for the ladder-of-investment hypothesis for the complete ladder, as in our main model. However, we also found no evidence for the ladder-of-investment hypothesis for the short ladder. Together with our other robustness checks, this suggests that there is only weak evidence for the ladder-of-investment hypothesis for the short ladder.

3.5 Conclusion

In this paper, we have proposed an empirical test of the ladder-of-investment hypothesis, and tested if service-based competition can serve as a stepping-stone for facility-based entry.

We built an empirical model that encompasses a complete ladder-of-investment, which is composed of three rungs: Bitstream access, local loop unbundling and new access network facilities. We tested the main hypothesis of the ladder-of-investment approach: that service-based competition serves as a stepping stone to facility-based competition. Using data from the European Commission's "Broadband access in the EU" reports, we find no empirical evidence in support of the ladder of investment hypothesis for the complete ladder. That is, we find no impact of the number of unbundled lines on investment in new access infrastructures

[1]The estimation results for the additional robustness checks presented in Subsection 3.4.5 are available upon request.

by new entrants in the following periods.

These results are robust when we take into account the migration effect, the number of access rungs, the development of broadband cable, regulatory performance, and the evolution of local loop unbundling rates.

We also studied an alternative specification, where new entrants climb a "short" ladder-of-investment and permanently rely on the incumbent's infrastructure when they have reached the last rung of the ladder. In contrast with our results for the complete ladder, we find weak empirical support for the ladder-of-investment hypothesis for the short ladder. In our main model, the number of past bitstream access lines has a significant and positive effect on the number of unbundled lines rolled out by new entrants, but this result is not robust to all alternative specifications.

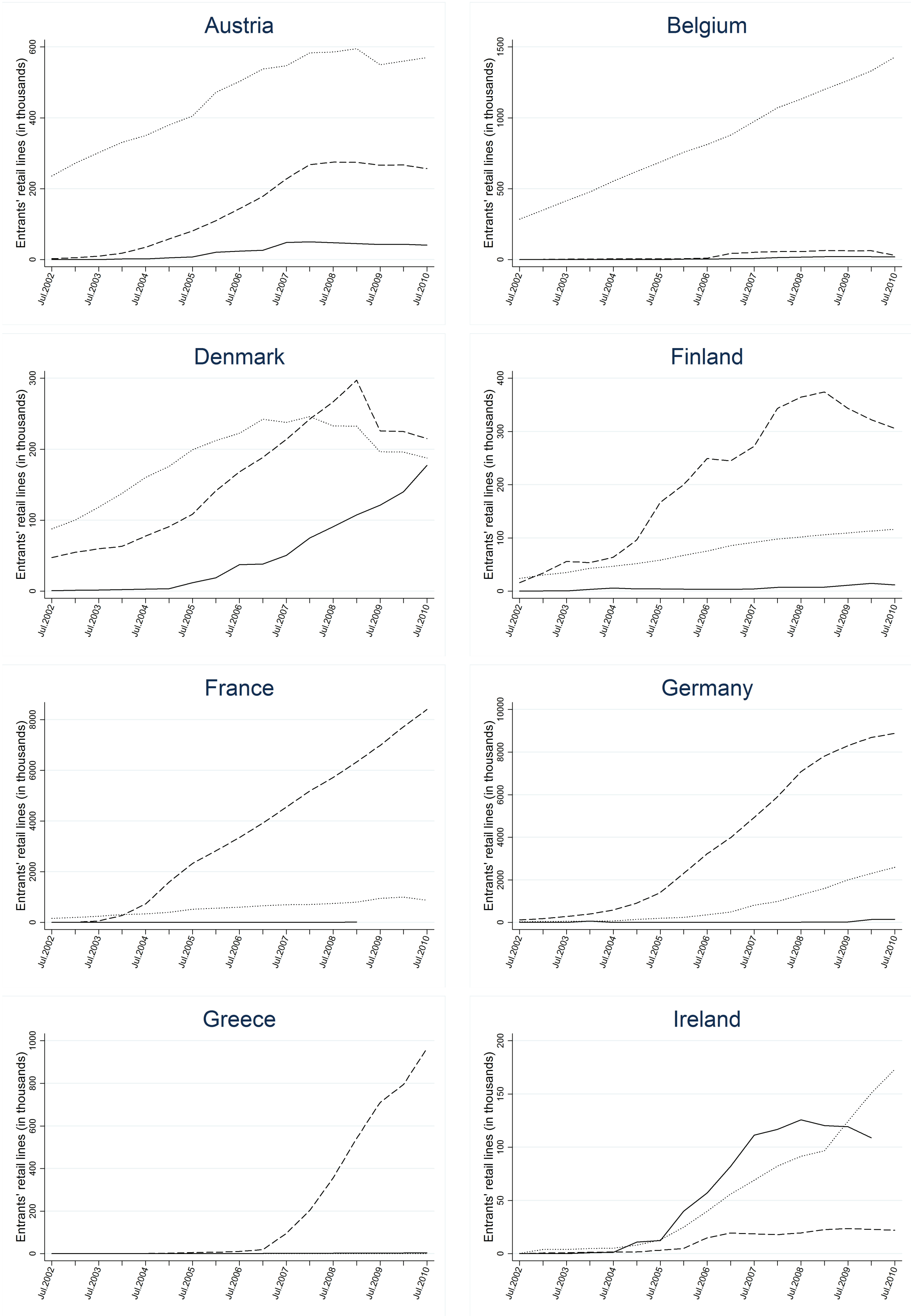
To summarize, our empirical results are consistent with the ladder of investment hypothesis only when we consider local loop unbundling as the last rung of the ladder. The ladder-of-investment approach seems to work for the migration from bitstream access to local loop unbundling, but does not work for the migration from local loop unbundling to a full access infrastructure. If the objective of the ladder-of-investment approach is to encourage entrants to build their own local access networks, our analysis casts some doubts on whether it is efficient in this respect.

3.6 Appendix: Summary statistics, Plots, and OLS and IV estimations

Variable	Mean	Std.Dev.			Min.	Max.	N	Source
		within	between	overall				
Newlines	53144.64	53449.6	94500.58	106780.9	0	613000	248	European Commission$^{(a)}$
LLUlines	910651.3	1354395	1279899	1835576	0	8878000	255	*Ibid.*
BAlines	274625.8	297115.9	406256.5	494070.9	0	2214000	252	*Ibid.*
incmob	0.3938	0.0455	0.1493	0.1515	0	0.6433	255	© Informa Telecoms & Media 2011. All rights reserved.
GDPpercapita	14512.75	856.253	5418.561	5314.553	6680.015	31847.13	255	OECD
mobpenrate	108.8136	17.1315	12.1668	20.7893	64.49	159.56	255	ITU and NRAs$^{(b)}$
density	159.3809	2.4057	126.5865	122.5582	17.0788	485.5785	255	OECD$^{(c)}$ and Eurostat$^{(d)}$
Pop	$2.60\text{x}10^7$	497627.6	$2.74\text{x}10^7$	$2.66\text{x}10^7$	446000	$8.28\text{x}10^7$	255	OECD$^{(b,c)}$
access	1.9529	0.5402	0.2181	0.5800	1	3	255	European Commission$^{(a)}$
Cable	0.5333	0	0.5164	0.4999	0	1	255	*Ibid.*
Polynomics	0.5512	0.0326	0.0946	0.0974	0.2488	0.7515	135	Zenhäusen *et al.* [2012]
P(LLU)	10.5604	1.6341	1.8180	2.4038	5.87	16.8	135	European Commission$^{(e)}$
δ	0.6583	0.4432	0.1797	0.4763	0	1	120	*Ibid.*

(a) Communications Committee, Working Document, COCOM "Broadband access in the EU: situation at 1 July 2008" (for data from July 2002 to July 2005), COCOM "Broadband access in the EU: situation at 1 July 2009" (for data from January 2006 to July 2009), European Commission Implementation Report No. 15 (for data of January 2010) and COCOM "Broadband access in the EU: situation at 1 July 2010" Main tables (for data of July 2010). (b) Missing variables have been extrapolated from third degree polynomial interpolations. (c) Except for France (source: INSEE). The OECD Factbook 2009 does not take into account overseas territories. (d) Except for France (source: CIA World Factbook). Eurostat does not take into account overseas territories. (e) From European Commission Implementation Reports No. 8 (data from 2002), No. 9 (2003), No. 10 (Aug. 2004), No. 12 (Oct. 2005, Oct. 2006), No. 14 (Oct. 2007), and No. 15 (Oct. 2008, Oct. 2009); and Electronic Communications Market Indicators (Digital Agenda Scoreboard 2011 Methodological Note) (Oct. 2010).

Table 3.8: Summary statistics


Austria
Belgium
Denmark
Finland
France
Germany
Greece
Ireland
Entrants' retail lines (in thousands)
Jul.2002
Jul.2003
Jul.2004
Jul.2005
Jul.2006
Jul.2007
Jul.2008
Jul.2009
Jul.2010

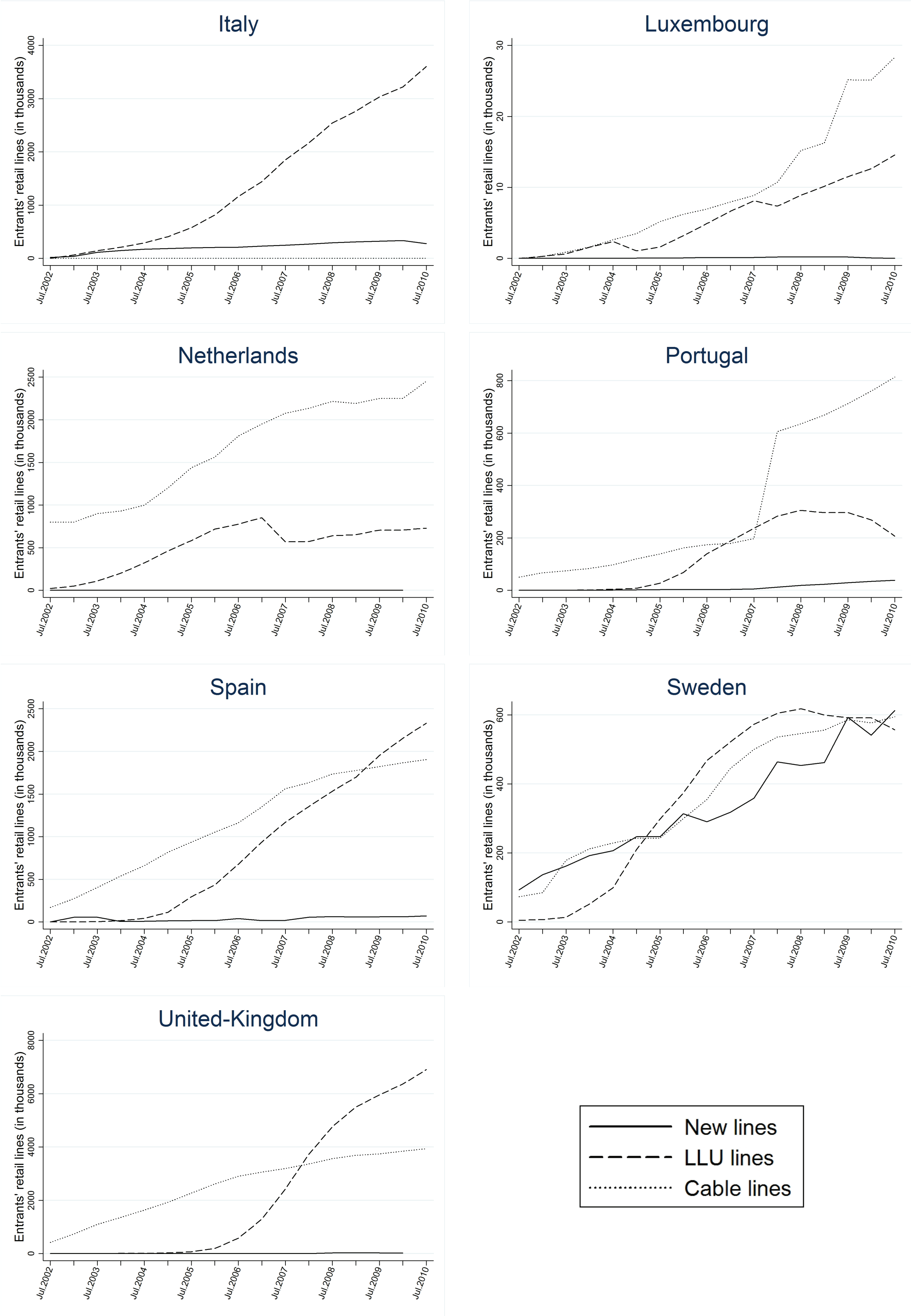
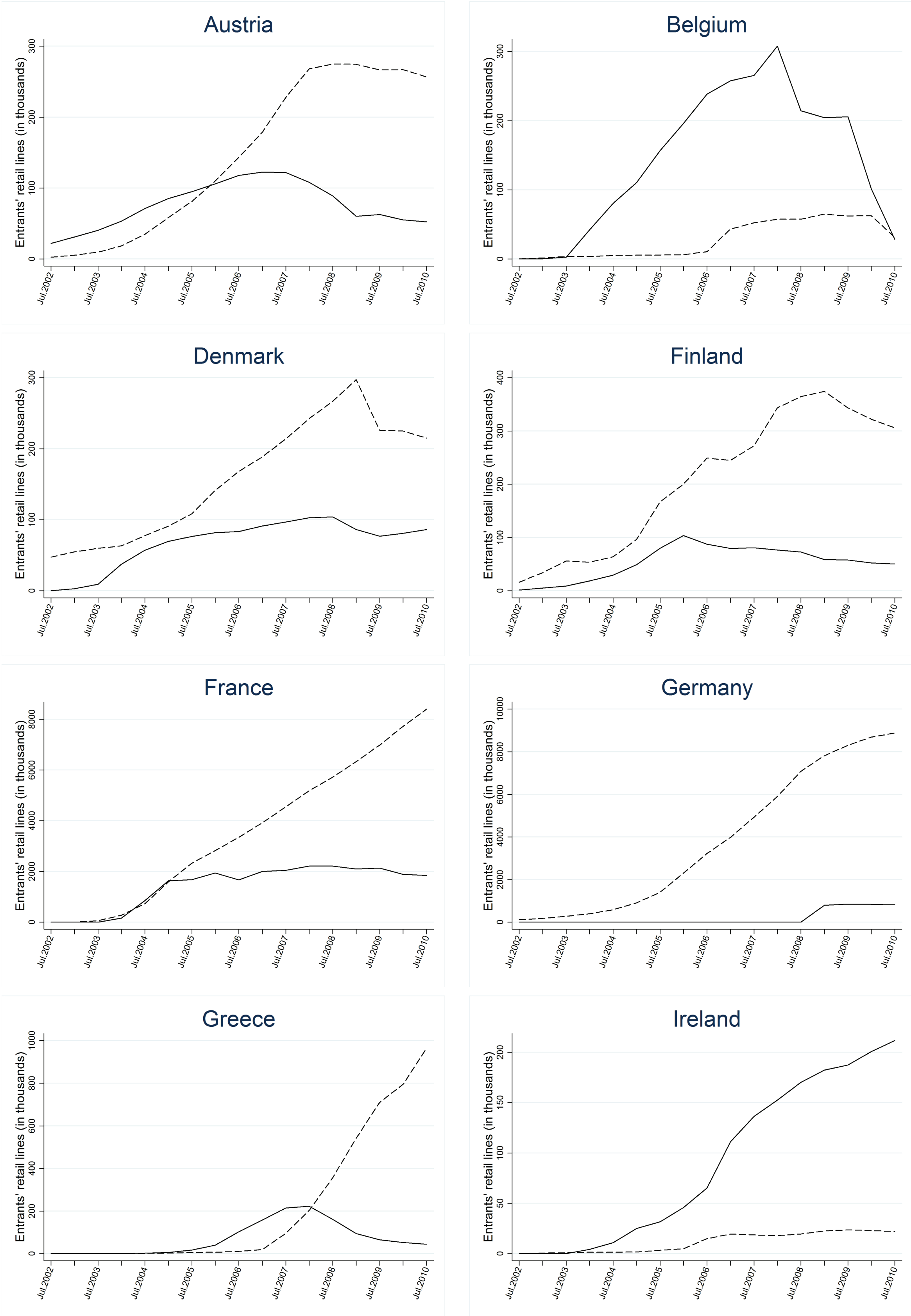


Figure 3.2: Time series plots for the complete ladder


Austria
Belgium
Denmark
Finland
France
Germany
Greece
Ireland
Entrants' retail lines (in thousands)
Jul.2002
Jul.2003
Jul.2004
Jul.2005
Jul.2006
Jul.2007
Jul.2008
Jul.2009
Jul.2010

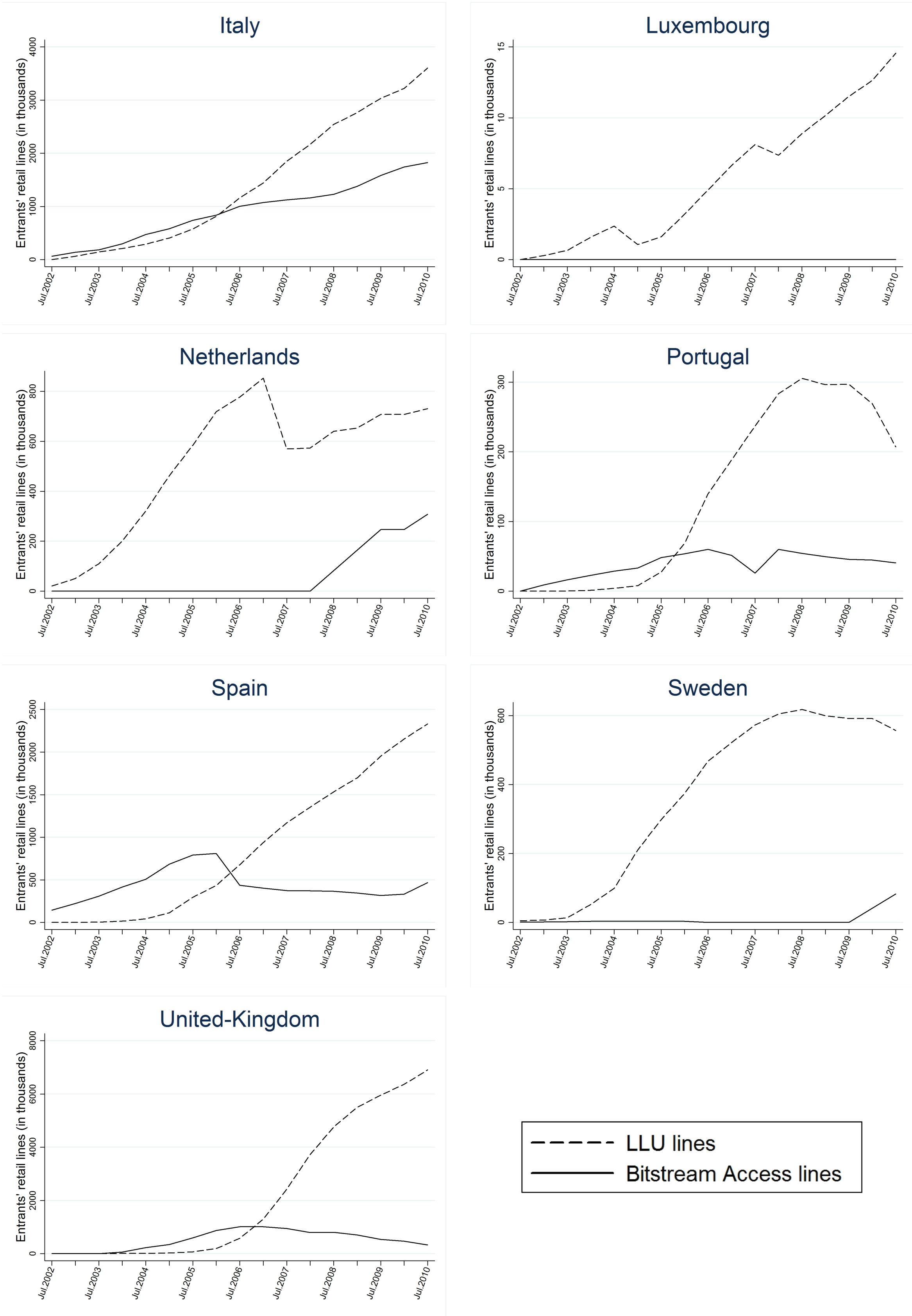


Figure 3.3: Time series plots for the short ladder

	Complete Ladder			Short Ladder
	OLS	IV		OLS
			First stage	
	$log(Newlines)_t$	$log(Newlines)_t$	$log(LLUlines)_{t-2}$	$log(LLUlines)_t$
$log(Newlines)_{t-1}$	0.685***	0.484***	0.0330	
	(13.27)	(6.09)	(0.73)	
$log(LLUlines)_{t-1}$				0.632***
				(5.66)
$log(LLUlines)_{t-2}$	0.0342	0.392		
	(0.50)	(1.35)		
$log(BAlines)_{t-2}$				0.0453**
				(2.42)
$log(BAlines)_{t-4}$			0.103***	
			(4.77)	
$incmob_t$	-1.075	-1.885	0.989	1.909*
	(-0.53)	(-0.83)	(0.65)	(1.82)
$log(GDPpercapita)_t$	-0.131	2.032	-6.010***	-0.847
	(-0.06)	(0.76)	(-4.37)	(-0.15)
$mobpenrate_t$	-0.0160	-0.0111	0.0194*	0.0155*
	(-0.97)	(-0.63)	(1.79)	(1.79)
$density_t$	0.0582	0.0584	-0.0290	0.0430
	(0.86)	(0.73)	(-0.54)	(1.47)
$log(Pop)_t$	-0.155	7.089	6.600	-5.491
	(-0.01)	(0.44)	(0.60)	(-1.38)
$constant$	-0.836	-143.5	-40.13	64.86
	(-0.00)	(-0.56)	(-0.23)	(1.33)
N	217	187	191	223
$R^2(within)$	0.700		0.824	0.977
$adj.R^2$	0.642		0.787	0.975
$Wald\ \chi^2(19)$		13566.12		
$(p-value)$		(0.0000)		
$F-test\ (country)$	2.82	3.32	23.40	2.80
$(p-value)$	(0.0008)	(0.0001)	(0.0000)	(0.0008)
$F-test\ (time)$	0.71	0.67	2.57	
$(p-value)$	(0.7657)	(0.7794)	(0.0039)	

Notes: t-statistics in parenthesis. Statistical significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Instrumented variable: $log(LLUlines)_{t-2}$, Instrument variable: $log(BAlines)_{t-4}$. Time fixed effects included in complete ladder specifications. Country fixed effects included in IV and OLS specifications, and corrected for in the first-difference GMM specification. Robust standard errors corrected for heteroskedasticity in the short ladder specification.

Table 3.9: Main results: OLS and IV

Chapter 4

Ex-ante Margin Squeeze Tests in the Telecommunications Industry: What is a Reasonably Efficient Operator?

4.1 Introduction

In recent years, competition authorities have dealt with high-profile margin squeeze (or price squeeze) cases in the telecommunications industry. For instance, the European Commission intervened in margin squeeze cases such as *Deutsche Telekom* in 2003, or *Telefónica* in 2007.[1] These cases have established the nature of a margin squeeze in competition policy and have characterized it as a stand-alone anticompetitive conduct: a margin squeeze occurs when a vertically integrated firm, providing an essential input to downstream competitors, sets retail and input prices that do not leave an economic space for efficient downstream firms to make positive profits.

Margin squeeze analyses are also popular among European National Regulatory Authorities (NRAs) of the telecommunications industry. According to a 2009

[1]Case COMP/C-1/37.451, 37.578, 37.579 - Deutsche Telekom AG, later confirmed by Case T-271/03 before the European Court of First Instance and Case C-280/08 P before the European Court of Justice; and Case COMP/38.784 - Wanadoo España vs. Telefónica, confirmed by Case T-398/07 before the General Court.

survey by the European Regulators Group (ERG), twelve NRAs declared having a procedure to conduct ex-ante margin squeeze analyses in at least one retail market.[1] As stated by the ERG, the purpose of ex-ante margin squeeze testing in a regulatory framework is different than in competition policy, because "while competition law is intended to prevent margin squeeze as an exclusionary abuse, ex-ante regulation seeks the more ambitious goal of promoting competition."

NRAs might conduct margin squeeze tests for three different reasons. Some NRAs employ ex-ante margin squeeze tests as a regulatory tool to set downstream price floors whenever the vertically integrated incumbent is dominant in both the downstream and upstream markets.[2] Alternatively, some NRAs use margin squeeze tests in a competitive downstream market as a regulatory tool for the upstream market as in a retail-minus mechanism. Finally, the tests are in some cases implemented to analyze the replicability of the unregulated retail offers of the incumbent on top of another access price control remedy.

Ex-ante margin squeeze tests will be a key tool in the regulation of next generation access (NGA) networks. Indeed, the 2010 European Commission's Recommendation on regulated access to NGA networks highlights that margin squeeze tests are appropriate when mandated access is not cost-oriented. Furthermore, when Neelie Kroes, the Vice President of the European Commission responsible for the Digital Agenda, announced in July 2012 the forthcoming Recommendation on non-discrimination, she stated that NRAs would have to analyze the economic replicability of dominant firms' offers through "a properly-specified ex-ante 'margin squeeze' test."[3]

Whereas competition authorities base the implementation of their margin squeeze tests on case law, NRAs have relied on general guidelines rather than on an explicit methodology. Only in 2010, the Commission's NGA Recommendation explicitly described a margin squeeze test based on a reasonably efficient operator (REO) as an alternative to the equally efficient operator (EEO) test established by competition case law. The Commission's Recommendation states that in

[1] See ERG [2009]. The European Regulators Group, has been replaced by the Body of European Regulators for Electronic Communications (BEREC) in 2009.

[2] When the test is implemented between two wholesale markets, a margin squeeze test is also called a "noneviction test."

[3] "Enhancing the broadband investment environment," policy statement by Vice-President Kroes, Brussels, 12 July 2012.

order to maintain effective competition, NRAs may consider margin squeeze tests according to costs and characteristics of a *reasonably efficient* operator that does not exhibit the same economic conditions than the incumbent. The Commission however does not define what “reasonably efficient” means; it only states that NRAs should properly specify in advance the methodology they will follow to implement such a test.[1] Therefore, NRAs’ appreciation in conducting ex-ante REO margin squeeze tests is large.

In practice, such tests have been implemented by European NRAs according to different methodologies. NRAs can build a bottom-up hypothetical efficient operator using parameters tuned from quantitative measures; they can use alternative operators’ actual costs and data; they can adjust the costs and economic conditions of the incumbent to account for new entrants’ disadvantages;[2] or they can combine these three approaches.

This paper analyzes the third approach, whereby NRAs make adjustments to margin squeeze tests based on the incumbents’ data in order to model a reasonably efficient operator. This paper identifies the ex-ante specific issues related to market asymmetries considered by NRAs, and provides a theoretical framework that allows to translate these issues into practical test adjustments.

As a result, this article concludes that REO margin squeeze test are different from EEO tests in three categories. The first category, usually considered as the main differentiating factor between REO and EEO tests relates to downstream cost disadvantages. Per unit downstream costs may be modified to take into account possible economies of scale, economies of scope, as well as other specific costs for the entrant. The other two categories are not formally associated to REO tests but they also follow the same rationale: they take into account the disadvantages of entrants in order to create a level playing field. The second category deals with access charge adjustments. When several wholesale products are available to entrants, several margin squeeze tests may be conducted according

[1]The forthcoming Recommendation on non-discrimination is expected to specify the relevant parameters for the test. The parameters of the so-called “economic replicability test” as proposed in the draft Recommendation are being vigorously debated given the particular context of NGA networks and their uncertain profitability. In particular, the BEREC insists on the introduction of a test based on REO parameters.

[2]This last approach has the practical benefit that NRAs can use incumbent’s data provided in the framework of accounting separation and cost accounting remedies. Some NRAs call this approach an “adjusted equally efficient operator” test or “similarly efficient operator” test.

to the notion of efficient entry as determined by the regulator. Finally, the third category explores possible price adjustments. Specifically, it covers adjustments related to bundling practices that could compromise the competing capacity of entrants.

Using this theoretical framework, this paper reviews the implementation of margin squeeze tests by European NRAs. Along with documents from the European Commission (EC) and the European Regulators Group (ERG), it also reviews decisions and guidelines from the following NRAs: RTR (Austria), BIPT (Belgium), ARCEP (France), BNetzA (Germany), ComReg (Ireland), AGCOM (Italy), OPTA (the Netherlands), UKE (Poland), Anacom (Portugal), CMT (Spain), and Ofcom (United Kingdom).

While this paper focuses on European regulatory authorities, the U.S. Federal Communications Commission (FCC) also refers to an hypothetical “reasonably efficient competitor” regarding the current regulation in place for the narrowband mass market and the business market.[1] The FCC explains that a reasonably efficient competitor should aim at providing all services to all consumers, as long as this is supported by the market;[2] but it also states that it would take into account entrants' disadvantages in providing multiple services, such as diseconomies of scope.[3] Nevertheless, because of the existing inter-platform competition in place between telecommunications incumbents and cable operators, there is no access regulation in the U.S. since the D.C. Court decision in *United States Telecom Association v. FCC* and the regulatory authority's Triennal Review Order released in 2003.[4] Therefore, the FCC does not use margin squeeze tests as an ex-ante regulatory tool in the U.S.

Hence, the benchmark analysis only focuses on European NRAs' and institutions' decisions. The aim of this case review is to illustrate the test modelling choices introduced in the theoretical section. The benchmark analysis does not seek to study an exhaustive list of margin squeeze tests implemented by European

[1]More precisely, in the current framework one of the standards needed to require the unbundling of a network element is that the lack of access to this element raises barriers to entry “that are likely to make entry into a market by a reasonably efficient competitor uneconomic,” when taking into consideration alternative suppliers, access types, or bypass opportunities. See FCC [2005], §51.317.

[2]FCC [2005], §25.

[3]FCC [2005], §24.

[4]See Bauer [2005] for an history of unbundling policy in the U.S.

NRAs in the telecommunications industry, but only aims at providing illustrating examples. However, this list is large enough to explore the main issues related to REO ex-ante margin squeeze tests.

Whereas this paper provides a comparison between NRAs' choices regarding ex-ante margin squeeze tests, this analysis does not aim at advocating EEO or REO tests, nor to endorse NRAs' implementation of margin squeeze tests, and whether or not these tests should be conducted regarding any particular regulatory context. Besides, this paper does not study the impact of ex-ante margin squeeze tests on investment or innovation, and do not define what "reasonably efficient" means. Its focus is rather to analyze the possible asymmetries between entrants and incumbents currently considered by European NRAs and the resulting range of implemented adjustments.

The rest of the paper is organized as follows. In Section 4.2 a review of the literature on the interplay between margin squeeze and regulation is provided. Section 4.3 introduces the two versions of a margin squeeze tests: the EEO and REO tests. A list of issues specific to ex-ante implementation of margin squeeze tests is developed in Section 4.4, and review the NRAs' conduct regarding these issues in Section 4.5. Section 4.6 concludes.

4.2 Literature on margin squeeze and regulation

The economic literature on margin squeeze is scarce and most of it deals with margin squeeze from a competition law perspective. Some papers study margin squeeze tests taking into account other regulatory obligations of the vertically integrated firm, but only a few discuss margin squeeze tests as an ex-ante regulatory tool per se.

Bouckaert and Verboven [2004] consider the relevance and the scope of ex-post margin squeeze tests in different regulatory environments. The authors study three different environments: full regulation (the incumbent's retail and upstream prices are fixed by the regulatory authority), partial regulation (only the incumbent's upstream price is fixed by the regulatory authority), and no regulation. They show that margin squeezes could be observed because of the regulatory authority's choices in a fully regulated environment, because of a predatory strategy from the incumbent in a partially regulated environment, or because of a foreclosure strategy in a unregulated environment. However, they only study the relevance of ex-post margin squeeze tests to monitor compliance with competition laws in a regulated environment, and not margin squeeze tests as a regulatory tool. They also discuss the appropriate aggregation level of margin squeeze tests for multi-product firms in their partially regulated environment.

Biglaiser and DeGraba [2001] study an incumbent's incentive to engage in a margin squeeze in order to foreclose a downstream rival. More precisely, they analyze the impact of the access charge level on the incentive to prey. In their model, the incentive to undertake a margin squeeze always decreases in the access charge.

Spector [2008] discusses how economic theory can provide some guidance for the implementation of margin squeeze tests when it is analyzed in terms of other well-known abuses of a dominant position (predatory pricing, excessive upstream pricing, etc.). He further points out three major concerns to be taken into account at the retail level: product differentiation, the scope of squeeze tests when considering multi-product firms (product-by-product vs. global tests), and the case of new products. Some of these sources of concern are also found in this paper benchmark analysis, which also reviews how NRAs deal with these issues.

Briglauer, Götz and Schwarz [2010] also study margin squeeze in a regulatory environment; they argue that a margin squeeze could be an indicator for market deregulation. They develop a theoretical model that demonstrates that a margin squeeze can result from regulation in combination with inter-modal competitive pressure, and not from an anti-competitive foreclosure strategy from the incumbent. In this regard, they advocate that NRAs should deregulate markets where inter-modal competition is strong enough, in order to avoid margin squeeze of intra-modal new competitors.

Despite the limited economics literature on the interplay between margin squeeze tests and regulation, the importance of margin squeeze tests in ex-ante regulation is highlighted in several policy analyses. For example, Briglauer and Vogelsang [2011] emphasize the relevance of considering an alternative wholesale access charge pricing formula to cost-orientation using forward-looking long run incremental costs. They justify the use of a new regulatory wholesale price formula because the margin squeeze issue becomes particularly predominant in contracting markets in the telecommunications industry. They explain that margin squeeze tests conducted ex-ante by NRAs are notably relevant and, hence, need to be carefully implemented.

By contrast, Ergas, Ralph and Lanigan [2010] describe the difficulties associated with margin squeeze testing for NGA services. The authors consider some critical issues for margin squeeze tests at the retail level. They express their concern about bundling, retail discounts related to offers with long-term commitments, low prices for new offers, nonlinear pricing and economies of scale. In addition, concerning implementation in practice, they stress the major difficulties that arise from retail product differentiation, wholesale product differentiation and bypass, and the possible "two-sideness" of markets. They argue that the number of false-positive test results can be high when these margin squeeze tests are implemented ex-ante, and that the cost associated with these errors is likely to be large. They conclude that margin squeeze tests should only be applied ex-post in NGAN markets, in the context of competition law.

Regarding the implementation of margin squeeze tests, authors have debated over the pertinence of EEO or REO tests in competition policy or regulatory frameworks. Geradin and O'Donoghue [2005] argue that REO margin squeeze tests are valid in a regulatory framework, where the regulatory authority promotes the entry of less-efficient operators in the short-run, expecting that they will become more efficient in the long-run. However, they state that REO standards should not be applied ex-post, as competition law should promote competition on the merits, which is consistent with the exclusion of less-efficient competitors. Similarly, Heimler [2010] explains that a standard that is favorable to entrants such as the REO test can only be applied by a regulatory authority, as it can estimate the trade-off between higher short-run costs for consumers and long-run benefits.

As one can see from this literature review, only few papers consider the interplay between regulation and competition law for margin squeeze tests. The economics of REO margin squeeze tests, which are widely used by European NRAs to define some of their regulation policies, are yet to be formally analyzed. The theoretical framework proposed in Section 4 thus constitutes a basis for further economic analysis on the impact of REO margin squeeze tests as a regulatory tool.

4.3 Margin squeeze: From theory to practice

This section introduces the two different margin squeeze tests defined by the European Commission and proposes a brief review of some implementation issues that are common to both tests.

4.3.1 Two different tests to demonstrate a margin squeeze

The European Commission's Recommendation 2010/572/EU on regulated access to Next Generation Access networks provides two alternative definitions of ex-ante margin squeeze test: the Equally Efficient Operator (EEO) test, and the Reasonably Efficient Operator (REO) test.

The EEO test The first definition of a margin squeeze test in the NGA Recommendation is given as follows:

> "Margin squeeze can be demonstrated by showing that the SMP [Significant Market Power] operator's own downstream operations could not trade profitably on the basis of the upstream price charged to its competitors by the upstream operating arm of the SMP operator ('equally efficient competitor' test) [...]"

Whereas this definition is to be used in ex-ante margin squeeze tests, it is to be noted that the EEO test has been formally designated as the adequate test to apply by ex-post competition law.[1] It provides legal certainty for dominant firms as they have knowledge of their own costs and access charges in order to assess the lawfulness of their own conduct. The EEO test is also consistent with the objectives of competition policy, as it guarantees that downstream competitors with lower costs would make a positive profit by buying the wholesale product and competing against the incumbent in the retail market. Accordingly, more efficient downstream competitors are not excluded from the market.

[1] See the cases *Deutsche Telekom* and *Telefónica*.

In an ex-ante setting, the adoption of the EEO test depends on the objectives of regulation at a certain state of development of competition in a given market. For instance, the impact of regulation and the introduction of competition on the incumbent's and entrants' investment and innovation might play an important role. As formulated in 2009 by the European Regulators Group: "where there are concerns about the incentives to invest and innovate, it is possible that a regulator would more likely use the equally efficient operator test."[1]

The REO test The NGA Recommendation also proposes an alternative to the EEO, the REO test:[2]

> "[...] Alternatively, a margin squeeze can also be demonstrated by showing that the margin between the price charged to competitors on the upstream market for access and the price which the downstream arm of the SMP operator charges in the downstream market is insufficient to allow a reasonably efficient service provider in the downstream market to obtain a normal profit (reasonably efficient competitor test). In the specific context of ex-ante price controls aiming to maintain effective competition between operators not benefiting from the same economies of scale and scope and having different unit network costs, a 'reasonably efficient competitor test' will normally be more appropriate."

As presented by the Commission, the REO test might be used ex-ante when there are asymmetries between the SMP and other operators.[3] This is typically the case of a new entrant which faces an already installed incumbent with significant market power in the downstream market. The adjustments of the REO margin squeeze test allow to create a level playing field, which would promote competition in the downstream market.

[1]ERG [2009], §55.

[2]Although the EEO and REO tests were first mentioned in the 1998 Notice on the application on competition rules to access agreements in the telecommunications sector, the 2010 NGA Recommendation provides for the first time a clear difference between the two and an explicit preference for the REO test in the context of ex-ante regulation.

[3]See also the Commission's comments pursuant to Article 7(3) of Directive 2002/21/EC in decisions EL/2010/1113 and IT/2010/1103.

However, it is not clear whether the Commission recommends adjusting for asymmetries in the downstream market whenever this market is considered competitive and exempted from regulation. In particular, in situations where the upstream market power of the vertically integrated operator is already addressed through other regulatory obligations, should a REO margin squeeze test be conducted?[1] The Commission has nevertheless indicated that margin squeeze tests should not in any case be used to regulate competitive downstream markets, but could be used to regulate SMP operators in upstream markets.[2] Clearer guidelines and economic analysis are thus necessary to better frame and understand the pertinence of REO adjustments, and more generally, the precise use of margin squeeze tests.

4.3.2 A simple theoretical margin squeeze test

A direct transcription of the EEO test, as previously described, compares the retail price p set by the incumbent with the sum of the wholesale access charge a and the incumbent's downstream cost c. There is no margin squeeze if the downstream branch of the incumbent covers its perceived upstream and downstream unit costs:

$$p \geq a + c. \tag{4.1}$$

This EEO imputation test guarantees that more efficient competitors are not excluded from the market. An entrant with downstream cost $c_E \leq c$ would make positive profits buying the wholesale product and competing against the incumbent.

By contrast, when conducting a REO test, NRAs have to adjust the imputation test defined by inequality (4.1) to take into account competitors' asymmetric conditions, that are for instance due to the presence of economies of scale and scope. Therefore, a REO test can hardly be defined by a simple formula, as the one expressed by inequality (4.1) for the EEO test. A theoretical framework,

[1] Indeed, the REO definition is ambiguous, as it refers to *maintaining* effective competition between operators while opening the possibility for asymmetric adjustments in downstream competitive markets. However, NRAs usually adjust their tests in order to compensate for short-run disadvantages an efficient entrant could face, whereas the latter would not need such adjustments in the long-run.

[2] See the Commission's comments pursuant to Article 7(3) of Directive 2002/21/EC in decisions IT/2010/1103 and PL/2010/1098.

which translates the various adjustments NRAs do to the EEO test in order to model a REO, is presented in Section 4 of this paper. Before inspecting these adjustments, a brief discussion of an important question in the implementation of margin squeeze tests is provided below.

4.3.3 The not-so-simple implementation of margin squeeze tests

The telecommunications industry is dynamic and marketing practices can be complex as services evolve according to innovation and technological progress. As Ergas, Ralph and Lanigan [2010] point out, there are several difficulties associated with the implementation of a simple margin squeeze test, as described by inequality (4.1). To name a few, these include retail discounts with long-term commitments offers, introductory low prices, learning-by-doing economics, or nonlinear pricing.

In particular, a common issue to the implementation of EEO and REO tests concerns the appropriate time frame for evaluating the profitability of a down-stream operator. There are two possible approaches: a period-by-period approach, and a dynamic approach.

The period-by-period approach assesses periodically the profitability of an activity within a given period of time, usually one year. With this approach, a margin squeeze test is conducted for each of these periods.

Alternatively, the dynamic approach evaluates the profitability of an activity over several years. Revenues and costs can be evaluated with the discounted cash flow (DCF) method, generally used to test if the net present value of cash flows is positive. Contrary to the period-by-period approach, the dynamic approach does not specify how costs should be recovered in each period; it allows for initial losses that are compensated by future high profits.[1]

As dynamic pricing (when price varies over time) is commonly observed in the telecommunications industry when new products or services are introduced in

[1] In practice, when the squeeze test takes place ex-post, the period-by-period approach generally compares the revenues and costs of the activity based on historical information extracted from the operator's accounts. By contrast, ex-ante tests use the best currently available information, based sometimes on short term forecasts. Note also that the test given by inequality (4.1) could be modified when using a dynamic approach, in order to take into account the evolution of costs, demand, and prices.

the market, imputation tests using the dynamic approach seem to be preferable. Indeed, a failure to pass the period-by-period imputation test might not indicate a margin squeeze conduct, but rather a penetration pricing strategy (when price increases over time). This is especially so when the product in question is characterized by network externalities and consumers find greater value in the product when the penetration rate is higher. Similarly, discounts and promotions or learning-by-doing effects related to new services favor imputation tests using the dynamic approach. As Spector [2008] puts it, "[l]ow introductory downstream prices may have innocent motives because both producers and consumers in new markets need to gain experience, and costs can usually be expected to decrease."

However, there are shortcomings in the dynamic approach. For instance, an imputation test may rely on unreasonable cost and demand forecasts. Besides, a positive net present value for the incumbent could be the result of a successful foreclosure strategy, as the dynamic approach would allow for the recoupment of initial losses induced by a predatory strategy.[1] Even so, all things considered, the European Commission and NRAs acknowledge the relevance of the dynamic approach in the telecommunications industry for EEO or REO tests, but they claim caution and suggest using the period-by-period and the dynamic approaches simultaneously whenever required.

The rest of the paper focuses on margin squeeze tests as conducted ex-ante by European NRAs, and on the adjustments that these NRAs make to the EEO margin squeeze test described by inequality (4.1) to model a REO. The next section builds a theoretical framework to take account of possible market asymmetries between entrants and incumbents.

4.4 Specific issues for building a REO margin squeeze test

This section reviews each specific issue to REO margin squeeze tests in detail. For each of these issues, it is first explained what would be the nature of the asymmetry between the incumbent and a new entrant. Then, an adjustment to

[1] As pointed out by the European Commission in its response to CMT [2007] guidelines, SG-Greffe (2007) D/202782, or in its *Telefónica* decision.

the simple imputation test described by inequality (4.1) is proposed.

Note that, when potential entrants are supposed to be more efficient than the incumbent, because of technological progress the incumbent did not benefit from when building its infrastructure for instance, a NRA may use a bottom-up margin squeeze tests such that the modelled REO is *more* efficient than the incumbent. However, in practice, all the reviewed cases are such that entrants were less efficient than the incumbent in the downstream market, and, hence, this section builds on the assumption that the modelled REO is *less* efficient than the incumbent.

The margin squeeze test is composed of three parameters: costs, access charge and retail price. Below, this paper analyzes possible adjustments that can be made for these three parameters.

4.4.1 Cost adjustments

This subsection analyzes three different cost adjustments made by NRAs when conducting their imputation tests: economies of scale, economies of scope, and entrants' specific costs.

4.4.1.1 Economies of scale

Firms in the telecommunications industry usually have to bear important fixed costs in order to enter the market, namely to build their own networks or their information systems. Because of these fixed costs, an increase in demand leads to a decrease in the average cost of production. With identical cost functions, firms with a higher demand will have a lower average cost than firms with a lower demand. Therefore, a potential entrant might find it unprofitable to enter the market when the incumbent already serves a high demand, and hence, benefits from lower average costs.

Suppose that the average cost of production decreases with the firm's demand D, that is $c = c(D)$ and $\partial c(D)/\partial D < 0$. In markets recently opened to competition, the incumbent's demand D_I is higher than the entrants' one, so the NRAs usually have to scale back the incumbent's market share to take into account economies of scale. To adjust the simple imputation test for economies of scale, an NRA may consider the average cost of the incumbent c, evaluated at $\widetilde{D}$, the expected demand served by an efficient entrant. $\widetilde{D}$ is evaluated by the regulatory authority and $c(\widetilde{D}) > c(D_I)$, as $\widetilde{D} < D_I$. The imputation test hence becomes:

$$p \geq a + c(\widetilde{D}). \tag{4.2}$$

It is straightforward to see how the test (4.2) differs from the test (4.1): the incumbent's cost is evaluated at a lower demand than the one it is actually serving.

4.4.1.2 Multi-product incumbent: Economies of scope

When the incumbent is active in several markets whereas the entrant is active in only one, the incumbent can benefit from a strategic cost advantage over the entrant if there are economies of scope. This is the case when there are potential cost-savings because of common costs that can be spread between two (or more) incumbent's products.[1]

Suppose that the incumbent sells two different retail products, product 1 and product 2. Suppose further that for some reason the entrant can only produce product 1. For instance, one could argue that as a new entrant it is not possible to offer all of the incumbent's product range that has experience in the market. The NRA may consider that it is *reasonably* efficient that at the time of entry only one product is offered, but that an efficient entrant will eventually produce other products in the long run if there are economies of scope. Let the total cost function of the incumbent be $C(q_1, q_2)$, where the incumbent sells q_1 units of product 1 and q_2 units of product 2. There are some economies of scope between products 1 and 2 if:[2]

$$C(q_1, 0) + C(0, q_2) > C(q_1, q_2).$$

Denoted by $c = c(q_1|q_2)$ is the incumbent's average cost of selling q_1 units of product 1, when it already sells q_2 units of product 2. The average cost of an entrant that is as efficient as the incumbent in the first downstream market is

[1] When analyzing economies of scope, it is worthwhile to consider a multi-product incumbent and entrants that cannot produce all of the incumbent's products. If entrants can compete on all of the incumbent's portfolio, the relevant modifications to the simple imputation test are described in the "Price adjustments" category.

[2] See, e.g., Panzar and Willig [1981].

$c(q_1|0)$: its average cost equals the incumbent's when the latter produces zero units of product 2.

The common fixed costs of producing products 1 and 2 are denoted by F.[1] It is assumed that no product-specific fixed costs and no difference in marginal costs of producing one product according to the number of other products that are sold.[2] Hence, when $q_2 = 0$, the incumbent's downstream average cost equals:

$$c(q_1|0) = c(q_1|q_2) + \frac{F}{q_1}.$$

Thus, when it produces a strictly positive q_2, the incumbent's additional cost for products 1 is only marginal, as the common fixed cost is already borne. The economies of scope advantage of the incumbent is therefore represented by the common cost, F.

The entrant could be squeezed due to the incumbent's economies of scope advantage. An adjusted version of the imputation test (4.1) would be for the NRA to take this cost difference into account in its margin squeeze test, by choosing a downstream cost in the interval $[c(q_I|q_2), c(q_1|0)]$.

This is represented in the following test, where α is chosen by the regulatory authority, with $\alpha \in [0, 1]$:

$$p \geq a + c + \alpha\frac{F}{q_1}. \tag{4.3}$$

First, consider the extreme case where $\alpha = 1$: inequality (4.3) becomes $p \geq a + c + F/q_1$. The test favors entry of competitors which are as efficient as the incumbent in the first market, taken in isolation. It requires the incumbent to set product 1's price as if it was not selling product 2 at all, and loses the advantage from its economies of scope. Second, consider the other extreme case, where $\alpha = 0$. It favors the incumbent as it allows it to fully take advantage of its economies of scope: product 1's cost does not include any share of common costs.

[1]For instance, a fixed cost common to both products may be the billing information system, or the rent paid by for the retail distribution infrastructures. Also, note that when there is a fixed cost in producing product 1, an NRA could also adjust the squeeze test for economies of scale.

[2]This analysis extends to including economies of scope at the marginal cost level, but to keep it as simple as possible it only focuses on common fixed costs, as they are particularly relevant in the industry. For example, difference in marginal costs may illustrate the ability of a vendor to sell both products to one consumer more rapidly than each product to two different consumers.

4.4.1.3 Entrants' specific costs

Entrants may have to bear specific costs relative to market entry or to interconnection to the incumbent's essential facilities, such as equipment collocation costs. When this is the case, the imputation test may be adjusted. Indeed, if the test is not adjusted, it offers the incumbent a competitive advantage due to cost asymmetries.

Suppose there is a per unit entrant's specific cost, c_S. If the NRA includes this entrant specific cost into the margin squeeze analysis, the imputation test becomes:

$$p \geq a + c + c_S. \tag{4.4}$$

Finally, note that, in telecommunications markets, incumbents often enjoy market power at the downstream level because they benefit from an incumbency advantage such as brand loyalty. This incumbency advantage is generally temporary and can be seen as an asymmetric consumer switching cost from the incumbent to an entrant.[1] In this case, the entrants' specific cost c_S can also be seen as the short-run marketing effort efficient entrants have to make to overcome this incumbency advantage, in order to attract the incumbent's consumers.

Policy perspectives All three cost adjustments aim at allowing entry of operators which are less efficient than the incumbent at the downstream level in the short run. One reason an NRA might want to induce entry of a firm that is less efficient than the incumbent is that its objective function is mostly based on maximization of consumer surplus [see, e.g., Guthrie, 2006]. In this case, competition from a less efficient entrant can increase consumer surplus as compared to no competition at all.

However, the main argument that is developed by NRAs to justify cost adjustments is a dynamic one. They argue that entrants may be less efficient in the short run but will become at least as efficient as the incumbent in the long run. In other words, cost asymmetries are generally thought to disappear in the long-run. Hence, NRAs have to balance short-term efficiency losses against long-term efficiency gains.[2] In this regard, one of the most difficult task for NRAs when

[1] See, e.g., Carter and Wright [2003].

[2] Note however that these long-term efficiency gains may be achieved in other markets.

adjusting for cost asymmetries with a view to obtain long-term efficiency gains is to estimate the market perspectives ex-ante, in order to determine the number of entrants that the NRA would like to see in the market in the long run.

4.4.2 Access charge adjustment: Wholesale product mix

The access charge that entrants have to pay to the incumbent in order to connect to its infrastructure can also be adjusted when conducting an imputation test. When several wholesale products are available to entrants, several imputation tests can be conducted to detect a margin squeeze.[1] These tests can be implemented either on each of the wholesale products, or considering a wholesale product mix.

Suppose n types of wholesale access products are available to entrants, with wholesale charges a_i, $i = \{1, ..., n\}$. The adjusted margin squeeze test that encompasses a wholesale product mix is:

$$p \geq \sum_{i=1}^{n} \gamma_i (c_i + a_i), \tag{4.5}$$

where $\gamma = (\gamma_1, ..., \gamma_n)$ is a weighting vector, with $\sum_{i=1}^{n} \gamma_i = 1$ and $\gamma_i \geq 0, \forall i = \{1, ..., n\}$, and c_i corresponds to the unit cost of the incumbent's downstream component associated with the access product of access charge a_i.

The regulatory authority can choose to conduct several imputation tests simultaneously, using different weighting vectors, or to conduct an aggregated test, taking into account a wholesale product mix, as described by inequality (4.5).

The adjustment that favors entry the most would be the one that states that any wholesale product has to allow for economic space on its own, with respect to the retail price. This would correspond to conducting n tests, with, for test number i, a weighting vector composed of $\gamma_i = 1$ and $\gamma_k = 0$ if $k \neq i$.

Policy perspectives When a European NRA regulates several levels of access to the incumbent's network, it usually follows the ladder of investment regulatory

[1]Several wholesale access products might be available because the NRA implemented the ladder of investment, for instance. In this case, a reasonably efficient operator would be expected to climb the ladder, step by step. However, it might simultaneously use different wholesale accesses in different geographical areas, investing more in its own network in high-density areas.

approach.[1] Thus, it implements a dynamic approach to access regulation with the view that long-term efficiency arises from competition and from entrants' investments at the Local Loop Unbundling (LLU) level or in their own infrastructures. This dynamic component of regulation should thus translate into margin squeeze tests.

In order to facilitate entry at all levels, NRAs may conduct one margin squeeze test per access level in the first place. Hence, competitors can enter the market at any access level that would be profitable in the short-run, and this level might change between different geographical areas with different population densities for instance. However, in the long-run, NRAs may prefer to induce entrants to invest in their own network facilities, or up to the LLU level. In order to do so, they can conduct a margin squeeze test adjusting for a wholesale mix of different access levels which would give entrants some incentives to climb the ladder of investment. Access charges at low levels of the ladder might demonstrate a margin squeeze, whereas access charges at the top of the ladder do not.

One major issue NRAs have to deal with in this case is the endogeneity of the entry and investment pattern. Surely, when NRAs want to give entrants some incentives to invest up to a given access level, they modify their access charges such that entrants find it more profitable to invest up to the chosen access level than to remain in their current state. However, as it will be seen from NRAs' decisions, the wholesale product mix used to set the level of access charges is often evaluated according to past market figures. Hence, access regulation is often endogenously determined with respect to entrants' strategies.

By contrast, a NRA might prefer not to interfere in entrants' business models and to focus on developing competition, regardless it is service-based competition (such as bitstream access, or LLU) or facility-based competition (where entrants invest in their own infrastructures). In this case, it could conduct one test for each access product, in order to ensure that no access charge leads to a margin squeeze.

Finally, note that some NRAs also conduct margin squeeze test between regulated access level to ascertain to that there is enough economic space between access levels for entrants to invest progressively in their own networks. Similarly,

[1]See Cave [2006] for an introduction to the ladder of investment approach, and Bacache, Bourreau and Gaudin [2013] for an empirical test.

some NRAs conduct margin squeeze tests between regulated and (lower) unregulated access levels in order to verify that the incumbent does not distort entrants' investment incentives and the establishment of a competitive wholesale market.

4.4.3 Price adjustment: Multi-product incumbent and bundling

When the incumbent is dominant in one retail market along with the upstream market, it can leverage its retail market power in other retail markets through a bundling strategy. The adoption of such a strategy may lead to market foreclosure.[1] Therefore, modifying margin squeeze tests in order to take such bundling strategies into account might be necessary. As explained by Ergas, Ralph and Lanigan [2010], an imputation test conducted on a bundle (for example, a fixed telephony-broadband internet dual-play bundle) might highlight a regular competitive strategy, whereas a test conducted on one of the bundle elements (for example, fixed telephony) might demonstrate a margin squeeze.

Suppose that the incumbent produces several retail products and offers these products to final consumers in a bundle at price $\overline{p}$. Product i's cost is denoted by c_i. Further assume for expositional simplicity that there are no economies of scale or scope.[2] Finally, single-product prices are not squeezing per se, so the NRA may check that the bundle price $\overline{p}$ does not induce a margin squeeze.

The REO imputation test an NRA might set up is also determined by the entrant's ability to replicate the incumbent's bundle offer. The two different cases are analyzed below.

Multi-product entrant When the entrant competes directly with the incumbent by selling a bundle of products, the regulatory authority can decide to conduct an aggregated test on the incumbent's price:

$$\overline{p} \geq a + \sum_{i=1}^{n} c_i. \tag{4.6}$$

This imputation test is just a multi-product version of the basic test given by inequality (4.1). This test is typically used when the bundle defines a relevant

[1] See, e.g., Carlton and Waldman [2002].

[2] One should refer to previous issues regarding the allocation of costs and access charges when the incumbent is a multi-product firm.

product market, on which entrants can compete with the incumbent.

Single-product entrant and price separability By contrast, when the entrant is active in one retail market only, the NRA might want to ensure that the bundle sold by the multi-product incumbent does not squeeze the entrant. As the incumbent's bundle price aggregates prices of several products, it is difficult for the NRA to conduct a margin squeeze test for one product only (i.e., the product sold by the entrant). The question is then: how to allocate a price to this product from the bundle price?

Suppose that the incumbent uses a mixed bundling strategy and sets three prices: p_1 and p_2 for products 1 and 2, respectively, and $\overline{p}$ for the bundle.[1] Assume that the entrant is only active in the market for product 1. In such market, one would normally expect to have $p_1 + p_2 \geq \overline{p} \geq \max[p_1, p_2]$. Indeed, if the first inequality did not hold, consumers would never buy the bundle.[2] Whereas if the second inequality did not hold, consumers would never buy any of the single products (but only the bundle).

The NRA has to determine whether or not the bundle price, $\overline{p}$, squeezes the entrant and prevents him from competing in the market for product 1. That is, the NRA needs to allocate a price $\hat{p}_1$ to product 1 from the bundle price $\overline{p}$. The upper bound of $\hat{p}_1$ is $\overline{p} - c_2$, which corresponds to the price of product 1 in the bundle when the incumbent sets a margin equal to zero for product 2. The lower bound of $\hat{p}_1$ is $\overline{p} - p_2$, which is the remainder of the bundle price less the price of product 2 when sold alone, assuming that the allocated price is above cost. Therefore, with mixed bundling,[3] the NRA chooses $\hat{p}_1 \in [\overline{p} - p_2, \overline{p} - c_2]$ in the test:

$$\hat{p}_1 \geq a + c_1.$$

[1] There are two bundling strategies: pure bundling, and mixed bundling. Pure bundling occurs when the consumers can only buy the bundle. By contrast, mixed bundling occurs when consumers can buy each of the products separately, or together in the bundle.

[2] It is assumed that the consumers do not save any cost (e.g. shopping cost) when they buy the bundle, as compared to the case where they buy one product (or both) separately.

[3] When the incumbent engages in pure bundling instead of mixed bundling, there is no single-product price set by the incumbent. Nevertheless, the allocated price to product 2 in the bundle can be defined by $\hat{p}_2 = \overline{p} - \hat{p}_1$. As the allocated prices are assumed to be above costs, $\hat{p}_2 \geq c_2$, and, hence, $\hat{p}_1 \leq \overline{p} - c_2$. This also leads to $\hat{p}_1 \geq u + c_1$, where u is the incumbent's upstream marginal cost; thus, $\hat{p}_1 \in [u + c_1, \overline{p} - c_2]$.

Written differently, it chooses $\beta \in [0,1]$ and conducts the following test:

$$\overline{p} - p_2 + \beta(p_2 - c_2) \geq a + c_1. \tag{4.7}$$

Having a look at the two extreme cases helps at understanding this adjustment. When $\beta = 1$, then $\hat{p}_1 = \overline{p} - c_2$, and $\hat{p}_1$ is high. This means that, for a given bundle price $\overline{p}$, the imputation test is easily satisfied. This favors the incumbent, as the margin it earns on the sale of a bundle is completely allocated to the first product (the one the NRA conducts the imputation test on).

By contrast, when $\beta = 0$, then $\hat{p}_1 = \overline{p} - p_2$, and, thus, $\hat{p}_1$ is low. In this case, the allocated price $\hat{p}_1$ compared to the access charge and the downstream cost in the margin squeeze test is much lower than the bundle price $\overline{p}$. Hence, the imputation test is more difficult to pass. This latter test is the one preferred by entrants, as the price allocation is such that the incumbent extracts the same margin from product 2 in the bundle than from an independent sale at price p_2.

Overall, an implicit price margin squeeze test favors the entrant compared to an aggregated bundle test. Indeed, expression (4.7) can be rewritten as $\bar{p} \geq a + c_1 + c_2 + (1-\beta)(p_2 - c_2)$ and compared to the aggregated bundle test (4.6). This shows that, when $\beta < 1$, the margin of the single-product 2 is taken into account when conducting the margin squeeze test price and the price floor for the incumbent's bundle is increased.

Policy perspectives If the regulatory authority aims at maximizing consumers surplus in a static framework, it may adjust the price level in the margin squeeze test whenever the incumbent sells a bundle of products that entrants are unable to reproduce. Indeed, this type of adjustment may help to introduce competition in the retail market, as it allows single-product entrants to compete with the incumbent's bundle. However, the effect on consumer surplus in the second market (the one with the service entrants cannot reproduce) has to be evaluated as well in order to draw a complete welfare (or consumer surplus) conclusion. Similarly, a NRA may favor entrants by adjusting its test to allow for single-product entry when it wants to refrain from any impact on firms' business models.

By contrast, the main argument for price adjustments in a margin squeeze test is a dynamic one. Indeed, when there are barriers to entry, multi-market entry is generally thought to be more difficult than single-market entry, as barriers to entry are higher for multi-product entrants. Therefore, single-market entry is sometimes considered as a stepping-stone for multi-market entry,[1] and a price-adjusted margin squeeze test that encourages single-market entry in the short-run may help the NRA to promote long-term multi-market competition.

4.4.4 Summary of ex-ante REO specific issues

Table 4.1 below summarizes the REO specific issues that can arise in ex-ante margin squeeze tests, classified in three categories.

Parameter	**Specific Issues**
Costs	Economies of scale Economies of scope Entrants' specific costs
Access charge	Wholesale product mix
Price	Bundling

Table 4.1: Ex-ante specific issues for margin squeeze tests

Note that issues related to access charges and prices may not be seen as specific to ex-ante margin squeeze tests and have also been considered in competition policy cases. However, these issues are particularly relevant in tests conducted by NRAs, as they often reflect transitory asymmetries between incumbents and entrants. Indeed, there might be several wholesale products because the NRA implemented a specific regulatory approach (the ladder of investment, for example), whereas, in the long run, only one wholesale product remains. Similarly, an entrant might be unable to reproduce the incumbent's bundle because it needs some time to do so. This static vs. dynamic trade-off has to be evaluated by the NRA in charge prior to the margin squeeze test modelling.

4.5 Benchmark analysis of economic issues

This section reviews NRAs' choices regarding the specific issues that have been previously considered. This benchmark analysis does not aim at being exhaustive,

[1] See, e.g., Carlton and Waldman [2002].

but rather at introducing some illustrative examples of how European regulatory authorities adjust their imputation tests in practice. All references to NRAs' guidelines and cases that are reviewed in this benchmark analysis are provided in the Appendix 4.7.[1]

4.5.1 Cost adjustments

As explained in the previous section, three different adjustments to be made to EEO imputation tests on the cost parameter have been identified.

4.5.1.1 Economies of scale

As the European Commission advocates in its Recommendation 2010/572/EU on regulated access to NGA networks, the BIPT and Ofcom clearly adjust their modelled efficient operator to take into account the retail market share differences between the incumbent and entrants.[2] In its 2007 guidelines, the BIPT states that the incumbent's retail market share can be reduced to 25% for cost calculation if important scale effects are observed. In its 2009 guidelines, it also explains that its REO has a 20-25% market share, following ERG [2003]. In the BT IPStream case, Ofcom " has chosen to scale back BT's volumes and has considered a range of volumes over which to model the costs of a similarly efficient entrant," because " [g]iven [BT's] scale, its costs are considerably lower than those faced by smaller scale operators." Ofcom then details the size it gives to an efficient entrant: "[t]he range of volumes is approximately 1.7m-2.5m subscribers by the end of the studied period, i.e. in 5 years' time."

ComReg [2012] takes a dynamic approach for the economies of scale adjustment.[3] The Irish NRA sets price floors for bitstream rentals by reference to a REO that would increase its market share over time as it "considers that it is logical to

[1] For some countries (e.g. U.K.), the NRA can also intervene as a Competition Authority in the telecommunications industry. The present paper only analyzes the NRA ex-ante decisions of such cases.

[2] ARCEP also states it would take market share into account when economies of scale exist: "market share" is listed as a parameter of an hypothetical model presented in Brussels, June 19^{th}, 2008. Presentation available at `http://www.cullen-international.com/ressource/138/0/helene-boi.pdf`

[3] Note that ComReg, the Irish NRA, mixes both bottom-up and adjusted top-down approaches in its imputation tests. See, e.g., ComReg [2012], §B33, p. 55.

use an REO as the hypothetical entrant, with a lower market share and therefore lower economies of scale, to set the minimum price floors for bitstream."[1] The cost model is computed on an assumed level of LLU take-up, which increases over the market review period (three years). Each year average subscriber bases using LLU for the REO are 51,000, 88,000, and 99,000, respectively.

ComReg [2012] also tests for margin squeeze between the regulated bitstream service and an end-to-end wholesale access product lower in the chain. For this second test, ComReg assumes that the hypothetical entrant would achieve a 25% market share.

On the contrary, BNetzA [2007] does not adjust its tests for economies of scale, as it aims toward a long-term analysis, where such cost asymmetries are overcome: "[a]s such, it can generally be assumed that specific competitor costs such as the realization of (temporary) lower economies of scale and scope than the dominant company, collocation costs and any differences in the customer structure have to be compensated in another way. [...] It can therefore be assumed that (additional) competitor-specific costs are generally of a temporary nature. Therefore, the (long-term) costs of the efficient competitor should generally not be higher than those of the dominant undertaking." This view is close to that developed in ex-post competition policy.

Note that OPTA [2001] does not adjust its tests for cost asymmetries neither, and focuses on the EEO standard used in competition policy, as its 2001 guidelines were jointly set with the Dutch competition authority, Nma.[2]

RTR, the Austrian NRA, conducts margin squeeze tests as a retail-minus price control.[3] Doing do, it uses the cost of the incumbent operator in an EEO fashion. However, the NRA leaves the door open for economies of scale adjustments in NGA network markets (RTR, 2010). But it makes it clear that a prerequisite for this adjustment would be that the NRA estimates market perspectives.

[1] ComReg [2012], §3.37.

[2] OPTA [2001], §28.

[3] The Austrian regulator (RTR) relies on margin squeeze tests when implementing its retail-minus approach to access pricing (see the Telekom-Control Commission's Official Decision M 1/10-92 of November 15, 2010, on wholesale access). This approach aims at securing a sufficient margin for fixed-network entrants as compared to the incumbent, while maintaining competition between fixed and mobile operators. The source of this retail-minus approach is explained in Briglauer, Götz and Schwarz [2011]: Increased competition from outside options may lead to a margin squeeze in the regulated market.

Similarly, Anacom [2007] makes no adjustment to the downstream costs of the dominant operator when performing margin squeeze tests for broadband access. Anacom also uses margin squeeze test as a retail-minus price control, and it argues that, in this regard, the test should refer to the dominant operator's cost. (Anacom also double-checked the relevance of incumbent's data by asking entrants to provide their cost information.)[1]

4.5.1.2 Multi-product incumbent: Economies of scope

As for economies of scale, the European Commission, in its Recommendation 2010/572/EU on regulated access to NGAN, gives its preference to REO tests, which take into account the differences between incumbents and entrants regarding economies of scope. In practice, NRAs use different cost models to adjust their imputation tests for economies of scope.

NRAs generally conduct their imputation tests using one of the following cost models: Short Run Average Variable Costs (SRAVC), Long Run (Average) Incremental Costs (LRIC), or Fully Allocated Costs (FAC).[2] Average Variable Cost allocation only takes into account short term variable cost, whereas a Long Run Incremental Cost model also includes fixed costs (considered as variable costs in the long run). In Fully Allocated Costs, variable costs are included as well as fixed costs and a share of common costs. There is also a cost model, which takes into account a share of common costs, called LRIC+, i.e., Long Run Incremental Costs plus a mark-up for the recovery of common fixed costs. In some circumstances, LRIC+ models are equivalent to FAC models. Finally, a cost model that is less common is the Stand Alone Costs (SAC) model, which includes all variable, fixed and common costs.

When looking at the test defined by inequality (4.3), a LRIC model would correspond to $\alpha = 0$, whereas a FAC model (or a LRIC+ model) would incorporate a share of common costs, that is, $\alpha \in (0, 1)$, and a SAC model would correspond to $\alpha = 1$. There are several practices to allocate common costs between products

[1]See Anacom [2007], p. 4. Also related to the economies of scale, Anacom adopted hypotheses on firm's demand for computing the average wholesale access cost for competitors. It considered that "launching an ADSL offer aims for at the least 13 thousand users, a number of customers which was reached, at the end of the first three years of the offer, by main other service providers."

[2]ITU's 2009 "Guide de la comptabilité réglementaire" resumes regulatory cost standards.

for the FAC model. They can be proportional to products' revenues, margins, or, for example, to the number of products sold in each market (in this case the share of common costs is $\alpha = q_1/(q_1+q_2)$).

In its BT IPStream decision, Ofcom clearly details its cost allocation decision and justifies it by the need to adjust for economies of scope. First, Ofcom states that only long-run costs are relevant in their margin squeeze test, as "[a] cost floor based on short-run measure of costs [...] would set a cost floor which a firm could price down to in the short-term but which would not be sustainable over a number of years where there are fixed costs to recover."[1] Second, Ofcom reviews all available long-run cost models: LRIC, FAC or LRIC+.[2] Third, the NRA states that "the appropriate cost floor would be one that incorporates an element for the recovery of common costs: e.g. FAC or LRIC+," because "Ofcom's benchmark of a similarly efficient entrant involves the same underlying cost function as BT's, but smaller economies of scope."[3] Finally, Ofcom conducted its test using Fully Allocated Costs, because this was the cost model used by BT in the cost information it provided to Ofcom.[4,5]

BIPT [2007] has a different approach from the one developed by Ofcom, as it prefers to conduct its tests using a LRIC model (or on a FAC model if LRIC information is not available).[6] The BIPT advocates the use of this cost model because it already adjusts its test for scale effects at the retail level (see above). It states that if the economies of scale adjustment is too difficult to conduct, the BIPT could use FAC or LRIC+ as a cost model, in order to adjust for common costs.[7] However, the BIPT does not justify its cost model choices as an adjustment for economies of scope asymmetries. Lastly, the BIPT can conduct some "combinatory tests" on several retail markets, in order to ensure that joint costs are recovered.

ComReg [2011] has also decided to employ LRAIC+, as this cost model "in-

[1] Ofcom [2004], §2.27.
[2] Ofcom [2004], §2.28.
[3] Ofcom [2004], §2.32.
[4] Ofcom [2004], §2.35.
[5] CMT also states it uses "Fully Distributed Costs" (similar to Fully Allocated Costs), and ARCEP states it uses Fully Distributed Costs or LRAIC for margin squeeze tests in the broadband sector, in presentations showed in Brussels, June 19$^{\text{th}}$, 2008. CMT presentation available at `http://www.cullen-international.com/ressource/145/0/jordi-canadell.pdf`
[6] BIPT [2007], §56 and 58.
[7] BIPT [2007], §65.

cludes appropriate amounts of variable, fixed and common costs, which is the calculus faced by any [alternative operator] when deciding to enter or expand." Hence, it would benefit consumers by promoting entry of alternative operators.

RTR [2010] explains that, in Austria, margin squeeze tests are conducted using avoidable cost for each product, simultaneously than an overall combinatory test on all products using forward-looking LRAIC. Besides, some more complicated adjustments might be introduced for margin squeeze tests in NGA network markets (RTR, 2010).

Finally, BNetzA [2007] does not adjust its tests for economies of scope, as it aims toward a long-term analysis, for which such cost asymmetries are overcome. Similarly, OPTA [2001] focuses on the EEO standard.

4.5.1.3 Entrants' specific costs

BIPT [2007] clearly includes entrants' specific costs in its imputation tests.[1] ARCEP [2006] also includes specific costs in its margin squeeze bottom-up model for the fixed telephony market, taking into account, for instance, collocation costs.

As for previous cost parameters, BNetzA [2007] does not adjust its imputation tests for entrants' specific costs, as it states that in the long-run there should be no cost difference between an efficient entrant and the incumbent.

All cost adjustments defined in this subsection are summarized in Table 4.2.

[1] BIPT [2007], §60 and 61.

Reference	**Economies of scale**	**Economies of scope**	**Entrants' specific costs**
European Commission [2010]	Yes.	Yes.	
European Regulators Group [2003]	Incumbent's market share reduced to 20-25%.	One approach is to calculate the incumbent's cost when disallowing economies of scope ($\alpha = 1$).	
Austria (RTR, 2010)	Not for non-NGAN markets.	Use of avoidable costs (single-product test) and LRAIC (combinatory test).	
Belgium (BIPT, 2007)	Incumbent's market share reduced to 25%.	Use of LRIC (or FAC) and combinatory tests.	Yes.
Belgium (BIPT, 2009)	Incumbent's market share reduced to 20-25%.		
France (ARCEP, 2006)			Yes (bottom-up model).
Germany (BNetzA, 2007)	No (long-term analysis).	No (long-term analysis).	No (long-term analysis).
Ireland (ComReg, 2011)		Use of LRAIC+.	
Ireland (ComReg, 2012)	Incumbent's market share reduced to 25% (for second test). Incumbent's market share reduced to a weighted average (51k, 88k and 91k LLU line share).		
Netherlands (OPTA, 2001)	No (EEO test).	No (EEO test).	
Portugal (Anacom, 2007)	No.		
United Kingdom (Ofcom, 2004)	Incumbent's demand reduced to 1.7-2.5 million subscribers (time period: 5 years).	Use of FAC.	

Table 4.2: Cost adjustments for ex-ante margin squeeze tests

4.5.2 Access charge adjustments: Wholesale product mix

Most NRAs conduct imputation tests using a wholesale product mix (see, e.g., ERG, 2009). When they use a mix of upstream access charges, they have to set the share of each upstream product (i.e., to determine the weighting vector γ).

In the fixed calls telephony market, ARCEP [2006] takes into account a mix composed of two different wholesale products: handover at the local exchange (80%), and handover at the tandem exchange level (20%). Furthermore, the wholesale mix is constructed as a mean of different rates which apply for peak and off-peak interconnections, based on consumer call profiles.

ComReg [2011] also uses a weighted average of interconnection rates at local (66%), tandem (24%), and double tandem (10%) levels. According to ComReg, this weighted average is appropriate to protect alternative operators' investments, and it will be updated if competitive conditions justify it.[1]

Regarding broadband markets, AGCOM and CMT use wholesale product mixes in their imputation tests. These NRAs define their wholesale mix weighting vector by using the current mix of wholesale products used by new entrants.[2]

Setting the weighting vector introduces an endogeneity problem, as it aims at reproducing the already existing usage pattern of the wholesale products. In this regard, two CMT members developed an interesting point of view stressing some possible drawbacks to the upstream product mix in CMT [2008b]. In this document, the authors explain their disagreement with the wholesale product mix established by CMT [2008a]. They state that this input mix does not require each wholesale product to be profitable on its own. Conducting imputation tests for each of the three upstream products, they show that potential competitors which would like to use a different basket of wholesale products than the one taken into account in CMT [2008a] imputation test might be squeezed out of the market.

Finally, note that RTR address the wholesale product mix issue in a different way. It focuses on evaluating the margin between the bitstream access and retail prices, and simultaneously, between the LLU and the bitstream prices. Therefore

[1] ComReg [2011], §4.48.

[2] See AGCOM [2010] for Italy, and CMT [2008a], p. 9, for Spain. See also the European Commission response to the 2010 AGCOM draft measure for Italy: European Commission, SG-Greffe (2010) D/12083. A similar analysis is conducted by the Dutch NRA; see the Commission's comments pursuant to Article 7(3) of Directive 2002/21/EC in decisions NL/2012/1407 and NL/2012/1407.

it ensures that there is no margin squeeze at any level, and that entrants are able to compete at the bitstream wholesale level (see RTR, 2008, p. 77).

All access charge adjustments analyzed in this subsection are summarized in Table 4.3.

Reference	**Wholesale product mix**
France (ARCEP, 2006)	Yes: local exchange 80%, tandem exchange 20% (bottom-up model).
Ireland (ComReg, 2011)	Yes: weighted average level of interconnection at local, single tandem, and double tandem levels (respectively 66%, 24%, and 10%).
Italy (AGCOM, 2010)	Yes: balance based on historical data at a national level and updated periodically.
Spain (CMT, 2007)	Yes.
Spain (CMT, 2008a)	Yes: balance based on historical data and updated every six months (LLU 73.8%, GigADSL 8.7%, ADSL-IP 17.5%).

Table 4.3: Access charge adjustments for ex-ante margin squeeze tests

4.5.3 Price adjustments: Multi-product incumbent and bundling

As explained in ERG [2009], bundling is a key issue in implementing margin squeeze tests. Regarding the price adjustments that can be made in order to take bundles into account, AGCOM [2010] guidelines explain that margin squeeze tests on bundles will be conducted using an aggregated test, thus replicating the incumbent's retail offer.[1] Similarly, RTR [2010] conducts its margin squeeze tests at the aggregated level only when the bundle is considered as replicable by entrants. These tests thus consider the whole bundle as a single product per se. [2]

BNetzA [2007] states that, since bundle replicability is the central issue, a case-by-case analysis is necessary to decide whether a per product or a per bas-

[1] See, AGCOM [2010], Annex 1, p. 63.

[2] Similarly, the Dutch NRA conducts margin squeeze tests on bundled products by comparing the aggregated bundle price to total costs, including fully allocated costs of the unregulated wholesale product when it is relevant. See the Commission's comments pursuant to Article 7(3) of Directive 2002/21/EC in decisions NL/2012/1407 and NL/2012/1407.

ket/bundle margin squeeze test should be conducted. More precisely, the German NRA states that margin squeeze tests could be conducted at an aggregate level only if "the practicability of a margin squeeze test is not called into question" and if "the bundles to be taken as a reference can also be offered by all efficient competitors in that particular combination."[1]

CMT [2007] does not exactly adjust its margin squeeze tests in order to take into account bundling; it conducts separated replicability tests for bundles. Indeed, for CMT's margin squeeze imputation tests, the "unit of reference is a specific offer/service- not the whole market."[2] The replicability test for bundles is conducted only if the incumbent is also dominant in one of the retail markets. If the incumbent practices mixed bundling, a first aggregated test is carried out. If the first test passes, an implicit pricing test is carried as described in expression (4.7), setting the implicit price to the lowest bound. If the first aggregated test is negative, the bundling offer is banned.

Bundles are also adjusted by the UKE in the ex-ante margin squeeze tests within the framework of the 2009 agreement concluded between the Polish NRA and the incumbent operator. The price of the bundle offer is tested by excluding other unregulated elements of the bundle at incremental cost level. This corresponds to $\beta = 1$ in inequality (4.7).

All price adjustments studied in this subsection are summarized in Table 4.4.

Reference	**Bundling**
Austria (RTR, 2010)	One aggregated test.
Germany (BNetzA, 2007)	Case-by-case basis.
Italy (AGCOM, 2010)	One aggregated test.
Poland (UKE, 2009)	Per product, implicit price net of incremental costs ($\beta = 1$).
Spain (CMT, 2007)	Not directly taken into account in imputation test: additional replicability test.

Table 4.4: Price adjustments for ex-ante margin squeeze tests

[1] See BNetzA presentation on margin squeeze tests, Brussels, June 19$^{\text{th}}$, 2008. Presentation available at `http://www.cullen-international.com/ressource/149/0/michael-schi.pdf`.

[2] See CMT presentation on margin squeeze tests, Brussels, June 19$^{\text{th}}$, 2008.

4.5.4 Synthesis of European practices

Overall, in the decisions and guidelines reviewed in this paper, NRAs have adjusted their margin squeeze tests in various ways over all three test parameters to model a REO. For adjustments over the cost parameter, most of the reviewed NRAs were concerned with issues related to economies of scale. Some of them have decided not to adjust their tests for it and followed the EEO approach, whereas some others have scaled back the incumbent's market share. In doing so, some of the NRAs have followed the European Regulatory Group guidelines, setting a 20-25% market share for the incumbent. On the contrary, NRAs have seemed to be less preoccupied by common cost recoupment than by economies of scale; maybe because of the difficulties associated in allocating common costs to different products. Finally, few NRAs have clearly added entrants' specific cost in their margin squeeze tests.

Adjustments on the access charge parameter of the margin squeeze test have almost been a consensus in the analyzed documents. In cases where there was more than one regulated access level, most NRAs have performed their margin squeeze tests by introducing a wholesale product mix based on the current state of the market. By contrast, an example of an NRA which tests each wholesale access separately is the Austrian regulatory authority, RTR. It is to be noted that the endogeneity induced by a mix determined on the current state of the market may be problematic to implement a regulatory approach, such as the ladder of investment.

Finally, the analyzed NRAs' documents on decisions related to conducting margin squeeze tests on bundled products have shown an important heterogeneity. Indeed, some NRAs have conducted REO margin squeeze tests by considering the bundle as a single-product, whereas some others have favored per-product tests. This heterogeneity can be explained by geographical market specificities, and whether or not the bundle product is replicable by entrants and constitutes a relevant product market.

4.6 Conclusion

This paper identified the main economic issues that are specific to the implementation of REO ex-ante margin squeeze tests by European National Regulatory Authorities. The margin squeeze tests might be adjusted to correct for market disadvantages, and the adjustments can be found on all test parameters, namely the downstream price, the access charge, and the downstream costs. This paper transposed these issues into practical test adjustments, so as to define precisely how NRAs could build a Reasonably Efficient Operator based on the incumbent's parameters. It further presented basic policy perspectives on the impact of such adjustments.

This paper also provided a review of current practices implemented by National Regulatory Authorities in European telecommunications markets. This review was conducted in the light of the test adjustments that had been defined. Some adjustments were found to be very similar across the authorities' decisions, whereas some others are dealt with quite heterogeneously. If European policy-makers aim at consolidating the telecommunications market, this calls for greater coordination among NRAs for REO margin squeeze test modelling.

As an extension of this work, it could be relevant to perform a systematic cross-country analysis on NRAs practices and to investigate the impact of REO ex-ante margin squeeze tests on investment and innovation. For instance, it would be interesting to know whether overcoming asymmetries via margin squeeze test adjustments in a REO framework has a positive or a negative impact on entrants' and incumbents' investments in Next Generation Access Networks.

4.7 Appendix: Reviewed decisions and guidelines

Geographical market	**Authority**	**Year**	**Document**	**Market**
Europe	EC (European Commission)	2010	European Recommendation 2010/572/EU on regulated access to NGAN	*Guidelines*
Europe	ERG (European Regulators Group)	2003	ERG Common Position on the approach to Appropriate remedies in the new regulatory framework	*Guidelines*
		2009	Report on the Discussion on the application of margin squeeze tests to bundles	*Report*
Austria	RTR	2008	RTR Communications Report 2008	*Guidelines*
		2010	Margin Squeeze Überprüfungen in der sektorspezifischen ex ante-Regulierung für Telekommunikationsmärkte Kritische Punkte und neue Herausforderungen	*Guidelines*
Belgium	BIPT	2007	Décision établissant des lignes directrices relatives à l'évaluation des effets de ciseaux tarifaires	*Guidelines*
		2009	Décision concernant le test de ciseaux tarifaires des lignes louées Ethernet	Leased lines
France	ARCEP	2006	Notice du test d'effet de ciseaux tarifaires téléphonie fixe	Fixed telephony
Germany	BNetzA	2007	Notes on margin squeezes as defined by section 28(2) para 2 TKG	*Guidelines*
Ireland	ComReg	2011	Response to Consultation Document No. 10/76 and decisions amending price control obligations and withdrawing and further specifying transparency obligations	Call origination and termination
		2012	Further specification to the price control obligation and an amendment to the transparency obligation, D06/12	Wholesale broadband access
Italy	AGCOM	2010	Delibera 499/10/CONS and Appendix	*Guidelines (Fixed networks)*
Netherlands	OPTA	2001	OPTA and NMa Price Squeeze Guidelines (OPTA/EGM/2000/200494, NMa /2201/12)	*Guidelines (Fixed networks)*
Poland	UKE	2009	UKE and TPSA Agreement concluded on 22 October 2009, and Annex 9	Wholesale broadband access
Portugal	Anacom	2007	Determination on the method to assess margin squeezes in Broadband offers provided by the PT Group	Wholesale broadband access
Spain	CMT	2007	Resolución MTZ 2006/1486	*Guidelines*
		2008a	Resolución AEM 2008/215	*Guidelines*
		2008b	Voto Particular de Marcel Coderch e Inmaculada López en su condición de Consejeros de la CMT en relación a la Resolución AEM 2008/215	
United Kingdom	Ofcom	2004	Direction Setting the Margin between IPStream and ATM interconnection Prices (BT IPStream)	Broadband Internet
United States	FCC	2005	In the Matter of Unbundled Access to Network Elements; Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (FCC 04–290)	*Guidelines*

Table 4.5: Reviewed decisions and guidelines

Part IV

Competition policy in the ICT sector

In Part IV we analyze research questions relative to (ex-post) competition policy in the ICT sector. We argue that it may be particularly complicated for competition authorities to intervene in markets in the ICT sector, as they may have specific features that are rarely observable in other sectors. Hence, a clear understanding of these markets and the effects of possible anticompetitive conducts often requires particular theoretical analyses taking into account these markets specificities.

In Chapter 5 we show that mobile telecommunications markets may provide switching costs that allow firms to implement profitable bundling strategies. To our knowledge, this rationale for product bundling is not observed in any other market or industry, except in the case of retail banking (this example is detailed in Chapter 5).

In Chapter 6 we demonstrate that the recent antitrust investigations in the electronic book (ebook) markets, both in the United States and in the European Union, have overlooked an important feature of these markets; namely that access to ebooks is only available after the purchase of a reader device. As they manufacture and sell them, ebook sellers (like Amazon, or Apple) also have market-power over devices.

Overall, in Part IV we demonstrate that ex-post intervention in the ICT sector may face implementation difficulties as competition policy relies heavily on past decisions, which may have been taken regardless of the ICT sector typical features. Hence, such intervention needs to be carefully implemented, by using ad-hoc theoretical models for instance.

Chapter 5

Bundling with Switching Costs

5.1 Introduction

In developing countries, mobile telecommunications markets are generally very competitive, with an important number of firms providing pre-paid offers to consumers that easily switch from one operator to another. Despite this very competitive environment, some mobile operators perform way better than the others, extracting high revenues, gaining large market shares, and having a low consumer turnover rate. These operators generally managed to offer both tied mobile communications and banking services, and these banking services are characterized by high consumer switching costs.

As an example, we can consider the strategy of Safaricom, the main telecommunications operator, in the Kenyan market. Safaricom was able to operate as a monopolist in the mobile-banking market, which is characterized by high non-pecuniary switching costs due to time-consuming administrative steps to close an account, because the regulation changes after Safaricom's entry blockaded its competitors. Making use of its mobile-banking service conditional on the purchase of mobile-communications, Safaricom was able to make large profits in the (competitive) mobile-communications market.

Similarly, switching costs and bundling strategies play an important role in the retail banking industry. Indeed, whereas tying and bundling arrangements are usually subject to antitrust laws in the U.S. and in Europe, specific rules apply to the banking markets. In the U.S., Section 106 of the Bank Holding Company

Act, established in 1970, sets a *per se* ban on the use of tying or bundling in the banking industry (White [1995], Litan [2003], Naegele [2005]). In Europe, concerns have been raised about the use of tying or bundling arrangements in the banking sector by the European Commission in its 2007 Sector Inquiry.[1]

Why does bundling particularly matter in such markets? We argue that the switching costs in these markets have a specific impact on the profitability of bundling strategies. Mobile operators which introduced mobile-banking services are able to earn high revenues in a competitive markets because there are high switching costs of terminating a mobile-banking contract. Similarly, the banking industry is characterized by the presence of high switching costs (Kiser [2002], Hannan and Adams [2011]), which can be pecuniary (early termination fees) or non-pecuniary costs (shoe-leather costs, administrative costs). These switching costs and their impact on tying and bundling strategies therefore form the main source of concern for antitrust authorities.[3]

However, as the Chicago School critique of the leverage theory argues, tying and bundling may not be dominant strategies *per se*.[4] Moreover, firms are not always better-off in the presence of switching costs (Klemperer [1987], Cabral [2012b]). Despite this, in this chapter we demonstrate that bundling can be rational *because* of the presence of switching costs.

The basic idea of the chapter is the following: a firm can develop asymmetric switching costs by bundling its monopolized good with switching costs to its other good, sold in a competitive market. Using this asymmetry, the bundling firm might overcome the loss of sales in its monopoly market through its extra-profit in the competitive one.

We develop a theoretical model in which bundling can be a dominant strategy because of the existence of switching costs. We find that if consumer switching

[1]It is a common practice for retail banks in Europe to make the purchase of a mortgage conditional on the acceptance of a current account. In France, 86% of banks tie their products in such a way, against 67% in Spain, 48 % in Italy, or 100% in Portugal.[2] The same pattern appears for tie-in sales of consumer loans and current accounts, or small and medium enterprises business loans and current accounts. In some countries (Portugal, Greece, the Netherlands), more than 30% of banks tie mortgages to life insurances. Source: Communication from the Commission, Sector Inquiry under Article 17 of Regulation (EC) No 1/2003 on retail banking (Final Report), COM(2007) 33 final.

[3]For instance, the European Commission states that tying raises switching costs. See paragraphs 34 and 37 of the Sector Inquiry.

[4]See Rey and Tirole [2007] for a review of the Chicago School argument.

costs attached to the monopoly product are high enough and if the consumer valuation for the monopoly product is low enough, the monopolist is better-off when bundling its products together, thus shifting the switching costs from the monopoly market to the competitive one. Moreover, we find that total welfare always decreases with bundling, as this pricing strategy reduces output in the monopoly market and increases consumers' transportation costs in the competitive market.

The profitability of tying and bundling has been questioned for a long time by economists. The leverage theory, according to which a firm would find it profitable to tie its monopoly product with its competitive one in order to drive its competitor out of the market, used to serve as a basis for several court decisions in the U.S. in the first half of the twentieth century, such as *International Business Machines Corp. v. United States* or *Standard Oil Co. v. United States*.[1] But this theory has been criticized by the Chicago School along the lines of the one-monopoly profit argument.[2]

However, since Whinston [1990], the Chicago School argument against the leverage theory has proven to be less robust than expected. Some authors have showed that the exclusion of a competitor through tying could be profitable because of the presence of economies of scale (Whinston [1990], Nalebuff [2004]), network effects (Carlton and Waldman [2002]), or a phase of risky R&D investment (Choi and Stefanadis [2001]).

Other authors have demonstrated that tying could be a dominant strategy without exclusion of the competitor. Tying might serve as a product differentiation strategy, which can increase both duopolists' profits (Carbajo, de Meza and Seidmann [1990], Chen [1997]). It might also be used as a rent-shifting strategy, allowing the monopolist to extract some of the surplus generated by the challenger's superior complementary product (Carlton, Gans and Waldman [2010]), or it might be profitable because of the existence of a phase of R&D investment (Choi [2004]).[3]

[1]International Business Machines Corp. v. United States, 298 U.S. 131 (1936), and Standard Oil Co. v. United States, 337 U.S. 293 (1949), respectively.

[2]See, for example, Director and Levi [1956], Bowman [1957], Posner [1976], and Bork [1978]. See also Rey and Tirole [2007] for a review.

[3]See also Armstrong and Vickers [2010] for a model in which both firms can bundle their products and compete through non-linear tariffs.

To our knowledge, the only paper which introduces switching costs in the tying literature so far is the one by Carlton and Waldman [2012]. They introduce switching costs in the complementary product market and show that tying can be optimal when firms can either sell or lease their products to consumers. Their analysis differs from ours because, in their paper, tying can also be optimal without switching costs. Moreover, in their setting, switching costs are attached to both firms' products in the tied market. Hence, our paper is the first to introduce switching costs as a potential reason for the dominance of a bundling strategy.

The remainder of this chapter is organized as follows. Section 5.2 introduces the model. The analysis is developed in Section 5.3 and we draw welfare implications in Section 5.4. Section 5.5 concludes.

5.2 The model

5.2.1 Model set-up

There are two firms, firm 1 and firm 2, and two products, A and B. The market for product A is called the primary market and the market for product B is called the secondary market. Both markets are of size t. The products are independent, that is, buying A is not required in order to consume B, and *vice-versa*. Firm 1 can be active in both markets, whereas firm 2 can be active in the market for product B only.[1]

The market for product B is competitive and is represented by a Hotelling line as in Klemperer [1987]. Firms 1 and 2 are located at positions 0 and t, respectively. Consumers are uniformly distributed with unit density along the line segment. A consumer located at $x \in [0, t]$ has a transportation cost x when buying product B from firm 1 and a transportation cost $(t - x)$ when buying product B from firm 2. All consumers have the same reservation price r for product B, which is assumed to be high enough to ensure full participation. They make a discrete choice between buying one product or the other.

In the market for product A, all consumers have the same reservation price, V, and do not face any transportation cost. Firm 1 can choose to sell its products

[1]Firm 1 can be a monopolist in market for product A because it is the owner of a patent, for instance.

A and B independently, or together in a bundle.[1] Without loss of generality, we normalize product A's marginal cost to zero.

We consider a two-period setting where $t1$ denotes the first period and $t2$ the second one. In each period $T \in \{t1, t2\}$, firm 1 sets a price p_A^T for product A, and firm $i \in \{1, 2\}$, sets a price p_i^T for product B. If firm 1 chooses to bundle, it sets a price $\bar{P}^T$ for the bundle, whereas firm 2 sets a price $\bar{p}_2^T$ for product B.

We make the standard assumption that consumers have independent preferences across periods for product B, so that they all relocate on the line segment between period $t1$ and period $t2$.[2]

The market for product B is a market without exit costs, whereas market for product A is a market with exit costs. An exit cost is a switching cost a consumer has to incur when she stops consuming the good.[3] That is, when a consumer buys product A from firm 1 in period $t1$, she has to bear an exit cost of $s \geq 0$ if she stops consuming product A from firm 1 in period $t2$.[4] When firm 1 only sells the bundle $A\&B$, this exit cost is transferred to the bundle and it becomes the exit cost that consumers have to bear if they buy the bundle $A\&B$ from firm 1 in period $t1$ and buy product B from firm 2 in period $t2$. We assume that all consumers have the same exit cost.

The timing of the game is as follows. Before the first period starts, firm 1 (the monopolist) chooses whether or not to bundle its products. Then, in the first period of the game, both firms set their first-period prices ($\bar{P}^{t1}$ and $\bar{p}_2^{t1}$ if firm 1 bundles, or p_A^{t1}, p_1^{t1} and p_2^{t1} if it does not), and consumers make their purchasing decisions. In the second period of the game, consumers relocate on the line segment, and firms set their second-period prices ($\bar{P}^{t2}$ and $\bar{p}_2^{t2}$ if firm 1 bundles, or p_A^{t2}, p_1^{t2} and p_2^{t2} if it does not), and consumers make their purchasing decisions.

We define q_i^T and π_i^T as firm i's quantity and profit in period T, respectively. Firms and consumers have the same discount factor δ, which we normalize to 1.[5]

[1] Throughout this chapter, "bundling" refers to pure bundling (or package tie-in).

[2] See, e.g., von Weizsäcker [1984], Klemperer [1987], Caminal and Matutes [1990], Shin and Sudhir [2009], Chen and Pearcy [2010], and Rhodes [2012], who use second-period consumer's tastes for underlying product characteristics that are (or may be) independent of their first-period tastes.

[3] Exit costs are sometimes also called 'termination costs' or 'closing charges.'

[4] For example, s can be the shoe-leather cost of closing an account.

[5] This normalization is relaxed for the welfare analysis.

We denote by $\Pi_i = \pi_i^{t1} + \pi_i^{t2}$ the total profit of firm i at the beginning of the two-period game.

5.2.2 Bundling without exit costs

As a benchmark, we study how a bundling strategy influences the equilibrium outcome when there are no exit costs attached to any of the products (i.e., $s = 0$). This preliminary section is close to the one in Choi [2004].[1] We show below that bundling is not profitable *per se*. Hence, all the profit-increase induced by bundling in our general model will be due to the existence of switching costs.

Independent pricing. When the monopolist does not bundle its products, the equilibrium in period $t1$ is similar to the one in period $t2$, as profits in period $t2$ do not depend on period $t1$ market shares.

In the market for product A, which is of size t, firm 1 is a monopolist, and all the consumers have the same valuation V. Therefore, firm 1 sets $p_A^T = V$ and earns a per-period profit of tV in this market. In the market for product B we have a standard Hotelling game, hence, the equilibrium prices are $p_i^{T*} = c+t$, for $i \in \{1,2\}$ and $T \in \{t1, t2\}$, and both firms earn $t^2/2$ in each period.

Summing profits in all markets, firms 1 and 2 earn the following total profits:

$$\begin{cases} \Pi_1 = \pi_1^{t1} + \pi_1^{t2} = t^2 + 2tV, \\ \Pi_2 = \pi_2^{t1} + \pi_2^{t2} = t^2. \end{cases} \tag{5.1}$$

Bundling. When the monopolist chooses to bundle its products, similar to the previous case, as profits in period $t2$ do not depend on period $t1$ market shares, the equilibrium in period $t1$ is similar to the one in period $t2$.

A consumer located at x buys the bundle $A\&B$ from firm 1 rather than firm 2's B product if and only if $r + V - \bar{P}^T - x \geq r - \bar{p}_2^T - (t - x)$, with $T \in \{t1, t2\}$. The first-order condition gives the equilibrium prices $\bar{P}^{T*} = c + t + V/3$ and $\bar{p}_2^{T*} = c + t - V/3$, and the equilibrium quantities are $\bar{q}_1^{T*} = t/2 + V/6$ and $\bar{q}_2^{T*} = t/2 - V/6$.

[1] Both models are slightly different, as we use the two-period setting of Klemperer [1987], with a market size of t and a unit transportation cost of 1, whereas Choi [2004] uses a market size of 1 and a unit transportation cost of t, in a one-period setting.

Similar to Choi [2004], we make the following assumption:

Assumption 5.1. $V < 3t$.

From the equilibrium demands, we can see that Assumption 5.1 ensures that firm 2 is never excluded from the market when firm 1 bundles its products, and when there are no exit costs attached to any product. Under this assumption, firms 1 and 2 earn the following profits:

$$\begin{cases} \bar{\Pi}_1 = \bar{\pi}_1^{t1} + \bar{\pi}_1^{t2} = t^2 + \frac{2tV}{3} + \frac{V^2}{9}, \\ \bar{\Pi}_2 = \bar{\pi}_2^{t1} + \bar{\pi}_2^{t2} = t^2 - \frac{2tV}{3} + \frac{V^2}{9}. \end{cases} \tag{5.2}$$

We can then state the following result:

Lemma 5.1. *Under Assumption 5.1, bundling is never a profit-maximizing strategy for the monopolist when there are no exit costs attached to the tying good.*

Proof. We have $\bar{\Pi}_1 - \Pi_1 = \frac{V}{3}(\frac{V}{3} - 4t)$. Hence, $\bar{\Pi}_1 - \Pi_1 > 0 \Leftrightarrow V > 12t$. Therefore, under Assumption 5.1, bundling is never a profit-maximizing strategy for firm 1 when there are no exit costs attached to the tying good. □

As under Assumption 5.1 bundling is not a profitable strategy *per se*, this highlights the importance of exit costs in our analysis.[1]

5.3 Bundling and asymmetric exit costs

We now consider that the tying good is a product with consumer exit costs. That is, if a consumer buys the tying good in the first period, she has to buy it also in the second period, or to incur an exit cost $s \geq 0$.

5.3.1 Independent sales

When the monopolist does not tie its products, then it sets different prices in markets for products A and B.

In the market for product A, as consumers are rational and their total utility of buying product A in both periods is $2V$, firm 1 cannot set a first-period price

[1] See Carbajo, de Meza and Seidmann [1990] and Chen [1997] for an analysis in which bundling can be a profitable product-differentiation strategy *per se*.

for product A higher than $V - s$; otherwise consumers will never buy product A. Indeed, a consumer who bought product A in period $t1$ is indifferent between buying or not product A in period $t2$ if $p_A^{t2} = V + s$. Therefore, the monopolist extracts all consumers' surplus in the market for product A by setting prices $p_A^{t1} = V - s$ and $p_A^{t2} = V + s$.

As there are no exit costs in the market for product B, we have a standard Hotelling game, as for the case of independent sales without exit costs.

To sum up, when firm 1 sells its products independently, the firms' total profits are the same as in the case of independent sales without exit costs, as expressed in equation (5.1).

5.3.2 Tie-in sales

We now study under which conditions bundling with exit costs can be profitable, when the monopolist's competitor is not excluded from the tied product market. This section's model builds on Klemperer [1987], but also departs from his analysis because only firm 1 can attach switching costs to its product (the bundle) and we consider that all consumers (and not only a fraction of them) have changing tastes from one period to another.

5.3.2.1 Second period

Consider that a fraction σ of consumers bought from firm 1 in the first period while the remaining fraction $(1 - \sigma)$ bought from firm 2. Let us assume that both firms sold a positive number of outputs in period $t1$ (i.e., $0 < \sigma < 1$). All consumers now have uniformly redistributed tastes for firms' B products.

Consider a firm 1's first period consumer, located at x in the second period. She buys firm 1's bundle in period $t2$ if and only if:

$$r + V - \bar{P}^{t2} - x \geq r - \bar{p}_2^{t2} - s - (t - x); \tag{5.3}$$

otherwise, she buys firm 2's product B only.

Now, consider a firm 2's first period consumer, located at x in the second period. She buys firm 2's product in period $t2$ if and only if:

$$r + V - \bar{P}^{t2} - x \leq r - \bar{p}_2^{t2} - (t - x); \tag{5.4}$$

otherwise, she buys firm 1's bundle.

Following Klemperer [1987], we assume that at least one consumer, but not all, switch from firm 1 to firm 2, and *vice-versa*, between periods. Therefore, the period-$t2$ consumers whose tastes match perfectly with firm 1's product B (i.e., located at $x = 0$) must buy the bundle from firm 1. This implies that some consumers who previously bought firm 1's bundle also buy it in the second period. Using equation (5.3), it must be that $t + \bar{p}_2^{t2} - \bar{P}^{t2} + s + V \geq 0$. Similarly, some consumers who bought from firm 2 in the first period now buy firm 1's bundle, and, hence, using equation (5.4) with the reversed inequality sign, it must be that $t + \bar{p}_2^{t2} - \bar{P}^{t2} + V \geq 0$.

Respectively, the period-$t2$ consumers whose tastes match perfectly with firm 2's product B (i.e., located at $x = t$) must buy this product. Some consumers who bought from firm 1 in the first period buy from firm 2 in the second period. Using equation (5.3) with the reversed inequality sign, it must be that $t + \bar{P}^{t2} - \bar{p}_2^{t2} - s - V \geq 0$. Similarly, some consumers who bought from firm 2 in the first period now buy firm 1's bundle, and, hence, using equation (5.4), it must be that $t + \bar{P}^{t2} - \bar{p}_2^{t2} - V \geq 0$.

These four conditions can be summarized as follows:

Condition 5.1. $t \geq |\bar{p}_2^{t2} - \bar{P}^{t2} + s + V|$ *and* $t \geq |\bar{p}_2^{t2} - \bar{P}^{t2} + V|$.

This condition is more restrictive than $\bar{q}_2^{t2*} > 0$ only (i.e., non-exclusion of the competitor), because it requires that firm 2 sells to both type of consumers in period $t2$ (i.e., both to loyal and switching consumers).

Under Condition 5.1, we obtain the following second-period demand system:

$$\begin{cases} \bar{q}_1^{t2} = \frac{1}{2}[\sigma(t + \bar{p}_2^{t2} - \bar{P}^{t2} + s + V) + (1 - \sigma)(\bar{p}_2^{t2} - \bar{P}^{t2} + t + V)], \\ \bar{q}_2^{t2} = \frac{1}{2}[\sigma(t + \bar{P}^{t2} - \bar{p}_2^{t2} - s - V) + (1 - \sigma)(\bar{P}^{t2} - \bar{p}_2^{t2} + t - V)]. \end{cases} \tag{5.5}$$

The first-order conditions for the two firms are $\partial\bar{\pi}_1^{t2}/\partial\bar{P}^{t2} = \partial[(\bar{P}^{t2} - c)\bar{q}_1^{t2}]/\partial\bar{P}^{t2} = 0$ and $\partial\bar{\pi}_2^{t2}/\partial\bar{p}_2^{t2} = \partial[(\bar{p}_2^{t2} - c)\bar{q}_2^{t2}]/\partial\bar{p}_2^{t2} = 0$.

Period-$t2$ equilibrium prices and outputs are:

$$\begin{cases} \bar{P}^{t2*} = c + t + \frac{V+s\sigma}{3}, \\ \bar{p}_2^{t2*} = c + t - \frac{V+s\sigma}{3}; \end{cases} \quad \text{and} \quad \begin{cases} \bar{q}_1^{t2*} = \frac{t}{2} + \frac{V+s\sigma}{6}, \\ \bar{q}_2^{t2*} = \frac{t}{2} - \frac{V+s\sigma}{6}. \end{cases} \tag{5.6}$$

The second-period second-order conditions are satisfied, as $\partial^2 \bar{\pi}_1^{t2}/(\partial \bar{P}^{t2})^2 = -1 < 0$ and $\partial^2 \bar{\pi}_2^{t2}/(\partial \bar{p}_2^{t2})^2 = -1 < 0$.

From equation (5.6), we see that, for a given first-period firm-1 demand σ, when firm 1 bundles its products, firm 2 is more aggressive than when firm 1 sells under independent pricing (since $\bar{p}_2^{t2*} < p_2^{t2*}$). Moreover, exit costs make firm 2 even more aggressive. Nevertheless, we see from equation (5.6) that firm 2 serves less consumers than under bundling without exit costs.

The resulting period-$t2$ equilibrium profits are:

$$\begin{cases} \bar{\pi}_1^{t2} = \frac{1}{18}(3t + V + s\sigma)^2, \\ \bar{\pi}_2^{t2} = \frac{1}{18}(3t - V - s\sigma)^2. \end{cases} \tag{5.7}$$

5.3.2.2 First period

We now analyze the first period of the game. Given period-$t2$ profits, and conditional on σ, we can write the total profits as follows:

$$\begin{cases} \bar{\Pi}_1 = (\bar{P}^{t1} - c)t\sigma(\bar{P}^{t1}, \bar{p}_2^{t1}) + \frac{1}{18}(3t + V + s\sigma(\bar{P}^{t1}, \bar{p}_2^{t1}))^2, \\ \bar{\Pi}_2 = (\bar{p}_2^{t1} - c)t(1 - \sigma(\bar{P}^{t1}, \bar{p}_2^{t1})) + \frac{1}{18}(3t - V - s\sigma(\bar{P}^{t1}, \bar{p}_2^{t1}))^2. \end{cases} \tag{5.8}$$

We assume that consumers make rational expectations about firms' second-period prices. Consumers observe their first-period position in the market, but they do not know what will be their position on the market line in the second period.

Consider a first-period consumer located at z. Her first-period surplus from buying from firms 1 and 2 are $(r + V - \bar{P}^{t1} - z)$ and $(r - \bar{p}_2^{t1} - t + z)$, respectively. If she chooses to buy from firm 1 in period $t1$, she will be indifferent between purchasing the bundle from firm 1 or product B from firm 2 if she locates at $\hat{x}$, defined such that $r + V - \bar{P}^{t2} - \hat{x} = r - \bar{p}_2^{t2} - s - (t - \hat{x})$. Therefore, this consumer's second-period surplus is:

$$CS_1^{t2} = \tfrac{1}{t}\int_0^{\hat{x}} (r + V - \bar{P}^{t2}(\sigma) - x)\,\mathrm{d}x + \frac{1}{t}\int_{\hat{x}}^{t} (r - \bar{p}_2^{t2}(\sigma) - t - s + x)\,\mathrm{d}x, \tag{5.9}$$

with $\hat{x} = (t + \bar{p}_2^{t2}(\sigma) - \bar{P}^{t2}(\sigma) + V + s)/2$.

Similarly, if she chooses to buy from firm 2 in period $t1$, she will be a period-$t2$ marginal consumer if she locates at $\hat{y}$, defined such that $r + V - \bar{P}^{t2} - \hat{y} = r - \bar{p}_2^{t2} - (t - \hat{y})$. Therefore, her second-period surplus is:

$$CS_2^{t2} = \tfrac{1}{t}\int_0^{\hat{y}} (r + V - \bar{P}^{t2}(\sigma) - x)\,\mathrm{d}x + \frac{1}{t}\int_{\hat{y}}^{t} (r - \bar{p}_2^{t2}(\sigma) - t + x)\,\mathrm{d}x, \tag{5.10}$$

with $\hat{y} = (t + \bar{p}_2^{t2}(\sigma) - \bar{P}^{t2}(\sigma) + V)/2$.

We know that the first-period marginal consumer is located at $z = \sigma t$ and is indifferent between buying from firm 1 or from firm 2, having rational expectations about the second period outcome. Therefore, this indifferent consumer obtains the same surplus under both choices:

$$(r + V - \bar{P}^{t1} - \sigma t) + CS_1^{t2} = (r - \bar{p}_2^{t1} - t + \sigma t) + CS_2^{t2}. \tag{5.11}$$

Using second-period equilibrium prices from equation (5.6) and consumer surplus values from equations (5.9) and (5.10), we solve for σ in equation (5.11). We obtain:

$$\hat{\sigma}(\bar{P}^{t1}, \bar{p}_2^{t1}) = \tfrac{3}{4} + \tfrac{3t}{s^2+6t^2}[\bar{p}_2^{t1} - \bar{P}^{t1} + V(1 + \tfrac{s}{6t}) - \tfrac{s+t}{2}]. \tag{5.12}$$

It is to be noted that $t\hat{\sigma}(\bar{P}^{t1}, \bar{p}_2^{t1})$ corresponds to firm 1's demand in period $t1$, when consumers have rational expectations about second-period prices.

Plugging $\hat{\sigma}(\bar{P}^{t1}, \bar{p}_2^{t1})$ into equation (5.8), we can now solve the following first-order conditions for the first period: $\partial\bar{\Pi}_1/\partial\bar{P}^{t1} = 0$ and $\partial\bar{\Pi}_2/\partial\bar{p}_2^{t1} = 0$. Moreover, it can be easily verified that the second-order conditions for the first period are satisfied, as $\partial^2\bar{\Pi}_1/(\partial\bar{P}^{t2})^2 = \partial^2\bar{\Pi}_2/(\partial\bar{p}_2^{t2})^2 = (-5s^2t^2 - 36t^4)/(s^2 + 6t^2)^2$, and $t > 0$.

As $\partial\hat{\sigma}/\partial\bar{P}^{t1} < 0$ from equation (5.12) and $\partial\bar{\pi}_1^{t2}/\partial\sigma > 0$ from equation (5.7), we have $\partial\bar{\pi}_1^{t1}/\partial\bar{P}^{t1} > 0$. That is, firm 1 competes more aggressively in period $t1$ than if there were no exit costs. Similarly, as $\partial\bar{\pi}_2^{t2}/\partial\sigma < 0$ from equation (5.7) and because $3t - V - s\sigma > 0$ from equation (5.6), and as $\partial\hat{\sigma}/\partial\bar{p}_2^{t1} > 0$ from equation (5.12), we find that $\partial\bar{\pi}_2^{t1}/\partial\bar{p}_2^{t1} > 0$; firm 2 also competes more aggressively in period $t1$ than if there were no exit costs to be borne in period $t2$. Moreover, we have demonstrated, in Section 5.2, that when firm 1 bundles its products in the absence of exit costs, both firms commit to a more competitive pricing strategy than with independent pricing. Hence, in the first period of this game with exit costs, both firms price more aggressively than in the case of independent pricing.

From the first-order conditions, we obtain the first-period equilibrium prices and demands:

$$\begin{cases} \bar{P}^{t1*} = c + t + \frac{V}{3} + \frac{s}{6}[\frac{s}{t} - 3 + \frac{s^2+3st-2sV+6tV}{7s^2+54t^2}], \\ \bar{p}_2^{t1*} = c + t - \frac{V}{3} + \frac{s}{6}[\frac{s}{t} - 1 - \frac{s^2+3st-2sV+6tV}{7s^2+54t^2}], \end{cases} \tag{5.13}$$

and

$$\begin{cases} \bar{q}_1^{t1*} = \frac{3t}{4} + \frac{t[V(7s+18t)-9t(s+3t)]}{2(7s^2+54t^2)}, \\ \bar{q}_2^{t1*} = \frac{t}{4} - \frac{t[V(7s+18t)-9t(s+3t)]}{2(7s^2+54t^2)}. \end{cases} \tag{5.14}$$

We can finally formulate firm 1's total equilibrium profits:

$$\begin{aligned} \bar{\Pi}_1 = \; & t^2 + \frac{2tV}{3} + \frac{V^2}{9} + s(\frac{5s}{32} - \frac{t}{6} + \frac{5V}{24}) \\ & + \frac{s}{7s^2+54t^2}(\frac{stV}{6} - \frac{17s^2t}{24} - \frac{7st^2}{16} - \frac{29t^2V}{4} + \frac{7sV^2}{72} + \frac{5tV^2}{2}) \\ & - \frac{st^2}{(7s^2+54t^2)^2}(\frac{s^3}{16} - \frac{9s^2t}{4} + \frac{13s^2V}{4} + \frac{sV^2}{4} + 9tV^2). \end{aligned} \tag{5.15}$$

5.3.3 Bundling incentives

We now analyze firm 1's bundling incentives. Bundling is a profitable strategy if $D(t, V, s) \equiv \bar{\Pi}_1 - \Pi_1 \geq 0$, where Π_1 and $\bar{\Pi}_1$ are defined in equations (5.1) and (5.15), respectively.

Before stating our main result, we need to define $s_{max}(V, t)$, which delimits the equilibrium domain for which both types of consumers (loyal and switching) exist for both firms in period $t2$. More precisely, $s_{max}(V, t)$ is the maximum value of s for which we have $0 < \sigma(\bar{P}^{t1*}, \bar{p}_2^{t1*}) < 1$ and Condition 5.1 is satisfied, where $\sigma(\bar{P}^{t1*}, \bar{p}_2^{t1*})$ is given by equation (5.13).

We can now state our main result:

Proposition 5.1. *There exists at least one couple (s, V) for which firm 1 is better-off when bundling, for any t.*

Proof. See Appendix 5.6.1. □

Proposition 5.1 demonstrates analytically that bundling might be profitable for the monopolist when switching costs are attached to the tying product, without exclusion of the competitor. This result is obtained by demonstrating that there always exists at least one value of exit cost for which the competitor is not excluded and for which bundling is profitable, at $V = 0$.

Even though bundling might be a profitable strategy, it would be interesting to know for which range of switching costs this is the case. However, we cannot answer this question relying on analytical solutions. In what follows, we therefore normalize the market size parameter t to 1 in order to analyze graphically firm 1's incentives to bundle.[1]

We plot $s_{max}(V, 1)$ in dashed line, which delimits the equilibrium domain. We can verify that $s_{max}(V, t)$ crosses the horizontal axis at $V = 3t$, as we can see that $s_{max}(3, 1) = 0$. Moreover, we plot $\bar{s}(V, 1)$ in solid line, which represents the couple values (s, V) for which the monopolist is indifferent between bundling and independent sales. For all parameters above this line that belong to the equilibrium domain, bundling is a profit-maximizing strategy. Figure 5.1 below shows that bundling is not always profitable, even if asymmetric exit costs are set up from this strategy.

We can then state the following result:

Proposition 5.2. *When $t = 1$, bundling can be a dominant non-exclusionary strategy for firm 1 if consumers' valuation for product A is low enough and if exit costs associated with this product are high enough.*

Proof. Numerical Proof. See Appendix 5.6.2. □

Proposition 5.2 shows that a bundling strategy is only profitable for low consumers' valuations for the tying product and for exit costs above $\bar{s}(V, t)$. Otherwise, independent sales of products is the most profitable strategy for the monopolist.

When some exit costs are attached to the bundle, firm 1 has an incentive to be more aggressive in the first period in order to capture a large number

[1] We also performed some robustness checks with other market size values. Our results remain unchanged.

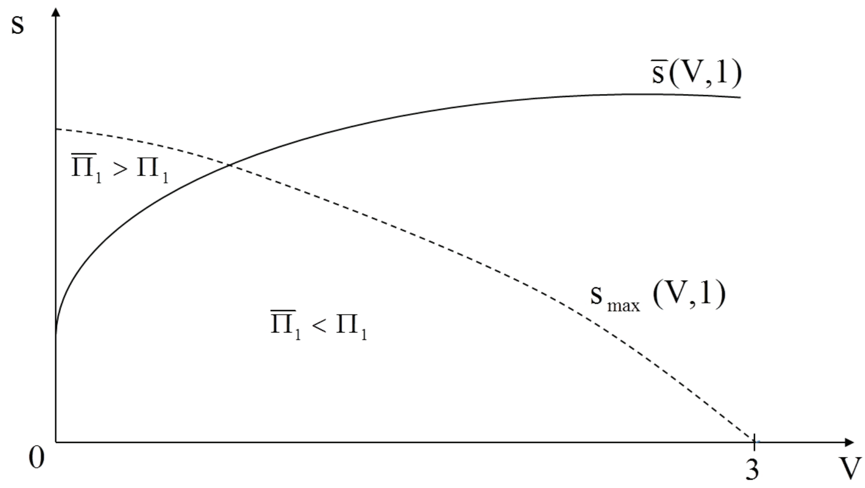


Figure 5.1: Firm 1's incentive to bundle when $t = 1$

of consumers which could be exploited in the second period. However, when it chooses to bundle its products, firm 1 incurs a profit loss in the monopolized market as it reduces its output in this market. Therefore, tie-in sales are profitable only when captive consumers bring about large second-period profits (i.e., s is large) and when the profit loss in the monopolized market is limited (i.e., V is small).

It is to be noted that, even with a pure exit cost asymmetry (i.e., for $V = 0$), bundling is not always a profitable choice. This result, which could seem peculiar at first, may be seen as the asymmetric version of Klemperer [1987], who showed that, in a symmetric setting with rational consumers whose tastes are independent between periods, firms are worse-off with exit costs. By contrast, in our setting, firm 1 might be better-off with the asymmetric exit costs it sets when bundling its products together.

Whereas the monopolist might be better-off with bundling, it is also interesting to analyze the impact of this strategy on its competitor:

Corollary 5.1. *When $t = 1$, firm 2 is worse-off when firm 1 bundles its products.*

Proof. Numerical Proof. See Appendix 5.6.3. □

Whereas bundling can be profitable for the monopolist for a certain range of parameters, it is never profitable for the challenger that the monopolist bundles its products together. Therefore, a mono-line supplier is hurt when tying is a profitable strategy for the multi-product firm. The effects of bundling on the mono-line suppliers' profits, and, hence, on competition, is at the core of the antitrust debate (see, e.g., the European Commission's Sector Inquiry on retail banking).

Nevertheless, our analysis only focuses on tying as a non-exclusionary strategy; so the effect on competition is limited. But one could easily conjecture that the presence of switching costs might also lead to tying being a dominant exclusionary strategy for the monopolist.

5.4 Welfare analysis

In this section, we analyze the welfare impact of bundling with asymmetric switching costs.

Independent sales. With independent sales, there is a duopoly in the market for product B and a monopoly in the market for product A. Both markets are covered, as consumers' reservation value in market for product A (i.e., V), is uniform and consumers' reservation value in market for product B (i.e., r), is uniform and high enough (i.e., $r >> t$). Consumers' total transportation costs are minimized, and equal $t^2/4$, as the indifferent consumer is located at position $t/2$, the middle of the Hotelling line. Hence, total welfare is easily calculated and equals $(1+\delta)[Vt + (r-c)t - t^2/4]$.

Tie-in sales. With tie-in sales and without exclusion of the competitor, the market for product B is covered. However, the sales in the market for product A are lower than under independent sales and they equal $\bar{q}_1^{t_1*}$ in period $t1$ and $\bar{q}_1^{t_2*}$ in period $t2$, with $\bar{q}_1^{t_i*} \leq t$, $\forall i$. Moreover, the total consumers' transportation costs are greater than or equal to $t^2/4$ in each period (they are equal to $t^2/4$, the minimum, if the indifferent consumer is located at $t/2$), and there is a welfare loss from incurred consumer switching costs with bundling. We can then state the following result:

Proposition 5.3. *Total welfare decreases with bundling.*

Proof. The market for product B is always covered. With independent sales, there is no switching consumer, and, hence, the allocation is first-best. With bundling, we observe a departure from this first-best, as there are some switching consumers. $\square$

Proposition 5.3 simply states that, as the only welfare effect of bundling is to reduce output in market for product A, to increase the consumers' transportation costs, and to create consumer switching costs, then total welfare decreases with bundling.

Whereas bundling has a negative impact on total welfare, its effect on consumer surplus is ambiguous. On the one hand, as indicated above, in market for product B, consumer surplus decreases with bundling. On the other hand, the impact of bundling is positive in market for product A, as consumer surplus equals zero under independent pricing (because the firm extracts all surplus). In the end, the overall effect of bundling on consumer surplus is indeterminate.

5.5 Conclusion

In this chapter we elaborated a new rationale for product bundling. We demonstrated that bundling can be a profitable strategy when consumer switching costs are attached to the product which is solely sold by the monopolist.

We showed that bundling might be a dominant strategy when compared to independent pricing, without exclusion of the competitor from the competitive market. This result holds as long as the switching costs associated with the monopolized product are high, and that the consumers' valuation for this monopolized product is low. The monopolist hence has an incentive to develop switching costs (e.g., administrative burdens) and then to tie its products. We also demonstrated that bundling always reduces total welfare.

Our model explains why bundling is a popular strategy in markets with switching costs, such as mobile communications and banking services, or retail banking, as observed by the European Commission. Finally, our welfare analysis can explain why specific rules, such as the Section 106 of the U.S. Bank Holding Company Act, might be necessary to deal with tying and bundling strategies in markets with switching costs.

5.6 Appendix: Omitted proofs

5.6.1 Proof of Proposition 5.1

We first determine $s_{max}(0,t)$. For $V = 0$, Condition 5.1 is equivalent to $t \geq \max\{2s\sigma/3, s(1-2\sigma/3)\}$. We have $s_{max}(0,t) = \min\{s_1, s_2\}$, with s_1 and s_2 being the solutions to the equations $t = 2s\sigma/3$, and $t = s(1-2\sigma/3)$, respectively. Using equations (5.12) and (5.13), we obtain

$$\begin{aligned} s_1 &= t[\tfrac{20}{21} + \tfrac{178*2^{\frac{2}{3}}}{21(-28381+189\sqrt{22865})^{\frac{1}{3}}} - \tfrac{2^{\frac{1}{3}}}{21}(-28381+189\sqrt{22865})^{\frac{1}{3}}], \\ s_1 &\approx 2.9111t, \end{aligned} \tag{5.16}$$

and

$$\begin{aligned} s_2 &= t[\tfrac{8}{21} + \tfrac{724*2^{\frac{2}{3}}}{21(-26905+189\sqrt{41513})^{\frac{1}{3}}} - \tfrac{2^{\frac{1}{3}}}{21}(-26905+189\sqrt{41513})^{\frac{1}{3}}], \\ s_2 &\approx 1.44007t. \end{aligned} \tag{5.17}$$

Therefore, $s_{max}(0,t) = s_2$, and it is positive for any $t > 0$.

We now demonstrate that it is always profitable for firm 1 to engage in bundling when $V = 0$ and $s = s_{max}(0,t)$. Plugging $s_{max}(0,t)$ into $D(t,V,s)$, we obtain $D(t,0,s_{max}(0,t)) \approx 0.0412791t^2$. Hence, we have $D(t,0,s_{max}(0,t)) \geq 0$, as $t > 0$. Therefore, it is always a dominant strategy for firm 1 to bundle its product when $V = 0$ and $s = s_{max}(0,t)$.

5.6.2 Proof of Proposition 5.2

Plotting $s_{max}(V,t)$ over $V \in [0,3t]$ for $t = 1$ shows us that $s_{max}(V,1) < 4$. We look for $s \in [0,4]$ solving the equation $D(1,V,s) = 0$.

We find numerically that only one real and positive solution to the equation $D(1,V,s) = 0$ exists for $V \in [0,3t]$. We call this solution $\bar{s}(V,1)$. $\bar{s}(V,1)$ always exists, and is unique, for $V \in [0,3t]$, $s \in [0,4]$, and $t = 1$. Therefore, there exists only one or zero real positive solution to the equation $D(1,V,\bar{s}(V,1)) = 0$ on the equilibrium domain, as illustrated by Figure 5.1. Moreover, from Figure 5.1, we can see that the only profitable bundling zone corresponds to low V and high s values.

5.6.3 Proof of Corollary 5.1

From equations (5.13) and (5.14), we can calculate firm 2's profit when firm 1 ties its products together:

$$\begin{aligned}\bar{\Pi}_2 = \quad & t^2 - \tfrac{2tV}{3} + \tfrac{V^2}{9} + s(\tfrac{7s}{96} - \tfrac{t}{6} + \tfrac{V}{24}) \\ & + \tfrac{s}{7s^2+54t^2}(\tfrac{-stV}{6} - \tfrac{13s^2t}{24} + \tfrac{st^2}{16} - \tfrac{25t^2V}{4} + \tfrac{7sV^2}{72} + \tfrac{5V^2}{2}) \\ & - \tfrac{st^2}{(7s^2+54t^2)^2}(\tfrac{s^3}{16} - \tfrac{9s^2t}{4} + \tfrac{13s^2V}{4} + \tfrac{sV^2}{4} + 9tV^2).\end{aligned} \tag{5.18}$$

From equations (5.1) and (5.18), we can compute $D_2(t, V, s) = \bar{\Pi}_2 - \Pi_2$, that is, the difference in firm 2's profits between the bundling and independent sales situations.

We look for the solution of the equation $D_2(t = 1, V, s) = 0$. We call $\bar{s}_2(V, 1)$ the real positive solution to the equation $D_2(1, V, s) = 0$, for $V \in [0, 3t]$, $s \in [0, 5]$, and $t = 1$. We find that $\bar{s}_2(V, 1)$ exists and is unique. We plot $\bar{s}_2(V, 1)$, the exit costs from which it is profitable for firm 2 that firm 1 only sells bundles.

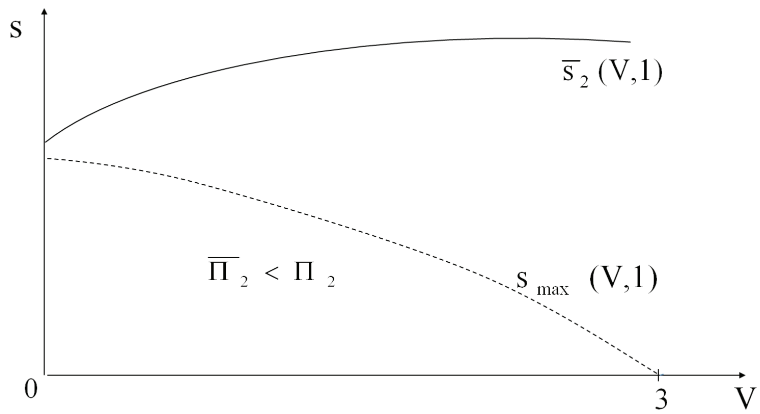


Figure 5.2: Difference in firm 2's profit when $t = 1$

We see from Figure 5.2 that, on the existence domain defined by $s \leq s_{max}(V, 1)$, it is never profitable for firm 2 that firm 1 bundles its product into a bundle. It is to be noted that this domain is defined such as firm 2 is never excluded from the market; so firm 2 always makes a positive profit.

Chapter 6

On the Antitrust Economics of the Electronic Books Industry

6.1 Introduction

Following the 2007 introduction of the Amazon Kindle device, the market for electronic books (ebooks) has grown from negligible to over $4 billion a year. During this time, the prices of ebooks have evolved in an interesting way. Originally, Amazon was effectively a monopolist distributor, and it sold ebooks at prices close to (and sometimes less than) the wholesale prices it paid to publishers. When Apple entered the ebook market with its own ebook store and its own electronic reader device (ereader), the iPad, it set up a new contract mode with publishers. This so-called "agency contract" differs from the classic "wholesale contract" used between Amazon and publishers in that it allowed publishers to set the retail price of ebooks. With this type of contract, Apple sells access to ebooks provided by publishers, and earns a share of revenue from ebook sales. Of course, Apple and Amazon also make some profit selling their ereaders. Following Apple's entry in the market, the major publishers forced Amazon to change its wholesale agreements to agency contracts.

This move had multiple effects. Because ebook prices have (apparently) gone up, a class-action was launched against Apple and the main publishers in the U.S. in August 2011, and the Department of Justice (DOJ) filed a suit against Apple and the publishers in April 2012. Simultaneously, the European Commission (EC) started to investigate the case. Both the DOJ and the EC claimed that Apple and the major publishers colluded on the type of contract (the agency contract) in order to raise ebook prices and earn supra-competitive profits. Therefore they have asked the major publishers to terminate their agency contracts with Amazon.

The authorities' decisions were based on the collusive behavior, and the impossibility for distributors such as Amazon to set the retail price.[1] However, antitrust investigations surprisingly disregarded the pricing of ereaders which give access to ebooks. In this paper, we study the relation between these prices and the ebook prices. There are some evidence that ereader and ebook prices are somehow related. For instance, Jeff Bezos, Amazon's CEO and founder, claimed that it sets low prices for its Kindle. "We sell the hardware at cost (...). We want to make money when people use our devices, not when they buy them," he explained in a BBC interview in October 2012, 11th.[2]

The "agency mode" we study in this paper, by which the publisher is allowed to set the retail price is related to the literature on resale price maintenance (RPM). Whereas RPM is not *per se* forbidden in the U.S., it is still carefully scrutinized by competition authorities, notably because of its collusive power (see, e.g., Jullien and Rey [2007], Dobson and Waterson [2007], Rey and Vergé [2008, 2010]). Note that the legal difference between RPM and agency mode is that distributors do not sell any product (nor do they have any stock) in the agency mode; they only sell a license to use the publishers' products (see Stoeppelwerth [2011]).

In this paper, we study distortions arising in both wholesale and agency modes. We analyze the equilibrium outcomes in both modes and, in particular, how retail prices compare to each other. More specifically, we show that in equilibrium the agency mode retail price can be higher than (or equal to) that in the wholesale mode, but that many common demand forms used in economics modeling restrict the analysis and induce a lower price in the agency mode.

We also extend the literature on two-part tariffs by a monopoly by introducing

[1]See Genesove and Mullin [2001] for a collusion case on the type of contracts used in the sugar industry.

[2]Losing money on one product while making profit on another is a well-known practice, called loss leading (Ambrus and Weinstein [2008], Chen and Rey [2012]). But in the present case, the vertical relationship between publishers and distributors plays an important role which is not captured by papers in the literature.

heterogeneous consumer valuations for access to variable goods (see, e.g., Oi [1971], Schmalensee [1981]; and Varian [1989], and Wilson [1997] for reviews). Our analysis also relates more broadly to the literature on multi-dimensional non-linear pricing (see Rochet and Stole [2002], and Veiga and Weyl [2012]).

Research on the ebook market is in its early stages, and the focus of the existing papers of which we are aware is quite different from ours. The closest work to ours is likely Johnson [2012b], who concentrates on the role that most favoured nation clauses play under both types of contracting arrangement. In another paper, Johnson [2012a] focuses on the role played by switching costs consumers face when changing distributor. Abhishek, Jerath and Zhang [2013] study entry and compare equilibrium outcomes in wholesale and agency modes when a monopolist publisher sells online goods through two competing distributors and this impacts its traditional brick-and-mortar business through spillovers. Importantly, note that none of the aforementioned papers consider ereader devices. Gans [2012], on the other hand, considers both media and devices but does not examine the impact of wholesale versus agency contracts.

Whereas we motivate this paper with examples from the ebook industry, our results also apply to other industries where an access device is valuable and allows consumers to buy some variable goods, such as telephony, or mobile applications.

The rest of this paper is as follows. In Section 6.2, we study a simple model in order to compare distortions arising when two vertically-related monopolists contract using the wholesale or the agency mode. In doing so, we show that, while wholesale mode often leads to higher prices than agency, this result is by no means general, and we explore the circumstances under which the opposite is true. In Section 6.3 we introduce the sale of ereaders and show that, when this ingredient is present, it can lead firms to set higher ebook prices in the agency mode than in the wholesale mode. Section 6.4 concludes.

6.2 Economics of “simple” wholesale and agency modes

In this section, we study the simplest case of vertically related monopolists contracting in either “wholesale mode” or the “agency mode.” We first show that, when demand for ebooks is of constant elasticity, the two modes always lead to the same equilibrium price. We then proceed to more general analysis, both by developing a simple, graphical representation of firms' pricing incentives and by considering the *adjustable pass through* class of demand functions [Fabinger and Weyl, 2012], whose flexibility allows for the equality arising under constant elasticity to be broken in either direction.

6.2.1 The basic model

A single publisher sells products to a single distributor, which then sells to final consumers. Assume that demand for the product, $D(\cdot)$, is twice-differentiable and decreasing in the retail price p. We call $p(\cdot)$ the inverse demand function. Assume that the publisher faces a constant marginal cost $c \geq 0$ for each product.[1] We now describe the two pricing arrangements.

Wholesale mode. The publisher chooses a wholesale price at which it sells (or licenses) products to the distributor. The distributor is then free to set the final price consumers must pay to purchase each unit. Formally, in the first stage, the publisher sets w, and, in the second stage, the distributor sets p_w. Such a model roughly corresponds to the terms under which Amazon and ebook publishers interacted before Apple's entry in the market.

Agency mode. The distributor announces a share of the total sales revenue that it will keep, offering the complementary share to the publisher. The publisher then sets the final price. Formally, in the first stage, the distributor sets the revenue share $\alpha \in [0, 1]$, and, in the second stage, the publisher sets p_a. This model more closely fits the arrangement that has prevailed between publishers and both Amazon and Apple, after the latter's entry into the market in 2010.

Before analyzing the results, we briefly motivate the modeling setup. An initial concern may be that, by comparing these two modes with one another in this way, we are, in addition, reversing the bargaining power of the two firms.

[1] For these digital goods, physical marginal cost is likely best approximated by zero; however, if publishers' contracts with digital good authors or developers require the former to pay a royalty to the latter for each unit sold, marginal cost may effectively be positive. See below in this section for further discussion of this issue.

While we are sympathetic to this potential criticism, we believe, for the following reasons, that this approach is the most reasonable one for the current analysis. First, the *sine qua non* of a comparison between these two modes is that, under wholesale, the distributor sets the final price, whereas, under agency, the publisher sets the final price. Second, given this first point, among the “simple” timing arrangements, the one that we have chosen for each mode is the *only* one that leads to a reasonable equilibrium prediction.

For example, if, in agency mode, the publisher moves first, then, assuming it chooses a price that is both itself nonzero and that leads to nonzero book sales, i.e., $p \in (0, p_{max})$, then the distributor will always set α equal to one, extracting all revenue. Anticipating this, so long as $c > 0$, the publisher will always choose some $p \geq p_{max}$, causing the market to break down. If the two move simultaneously, a similar result holds. Thus, the only feasible way to “hold fixed” the two firms' bargaining power while comparing the two modes would involves introducing significant additional machinery to the model (e.g., using Nash Bargaining Solution) at the cost of significant additional complication. Moreover, to the extent final prices are, in fact, easier to adjust on a rolling basis than inter-firm transfer arrangements, the timing we assume may indeed be quite realistic.

6.2.2 Constant elasticity demand

Let us first consider a simple example leading to striking results, in order to motivate our analysis. Consider the case of constant-elasticity demand functions: $D(p) = \beta p^{-\epsilon}$, with $\beta > 0$ and $\epsilon > 1$. Assume that the publisher's marginal cost is strictly positive, i.e., $c > 0$. The game is solved by backward induction in both modes.

Wholesale mode. In the last stage of the game in the wholesale mode, the publisher has already set the wholesale price w. The distributor profit is then $\pi_D(p) = (p - w)\beta p^{-\epsilon}$. The first-order condition (FOC), $\partial \pi_D / \partial p = 0$, leads to $p_w = \epsilon w/(\epsilon - 1)$ in equilibrium.

In the first stage of the game, the publisher sets w in order to maximize its profit $\pi_P(w) = (w - c)\beta p_w^{-\epsilon}$, with the price p_w derived as above. The FOC, $\partial \pi_P / \partial w = 0$, gives us $w = \epsilon c/(\epsilon - 1)$ in equilibrium. Therefore, the equilibrium retail price p_w in the wholesale mode in the constant-elasticity demand case is: $p_w = c/(1-1/\epsilon)^2$.

Agency mode. In the last stage of the game in the agency mode, the distributor has already set the revenue share α. The publisher profit is then $\pi_P(p) = [(1-\alpha)p - c]\beta p^{-\epsilon}$. The FOC, $\partial\pi_P/\partial p = 0$, induces that the publisher sets a price $p_a = \epsilon/(\epsilon-1) * c/(1-\alpha)$ in equilibrium.

In the first stage of the game, the distributor sets α in order to maximize its profit $\pi_D(\alpha) = \alpha p_a \beta p_a^{-\epsilon}$, with the price p_a derived as above. The FOC, $\partial\pi_D/\partial\alpha = 0$, leads to $\alpha = 1/\epsilon$ in equilibrium. Hence, the equilibrium retail price p_a in the agency mode in the constant-elasticity demand case, $p_a = c/(1-1/\epsilon)^2$, equals p_w. This result is summarized in Proposition 6.1 below.

Proposition 6.1. *The equilibrium retail prices in the wholesale mode and in the agency mode are equal when demand is of constant elasticity.*

The results obtained in this simple example, namely that equilibrium retail prices in both modes are equal when the demand function has a constant elasticity, show that a deeper economic analysis is needed in order to determine the effect on retail prices from a switch from one mode to the other. Below, we first present a graphical analysis to give clearer insights, and then we provide analytical results.

6.2.3 Graphical analysis

In order to give a better intuition for our results, we assume, for this graphical analysis only, that there exists some "maximum price," p_{max}, at or above which demand is zero, i.e., $D(p_{max}) = 0$, and that there exists some finite maximum quantity demanded in the market when the price is zero, $q_{max} \equiv D(0)$. (We allow for vertical and horizontal demand function asymptotes in the analytical analysis below.)

Zero marginal costs. First consider the case where $c = 0$. Here, it is immediately clear that, while the wholesale mode leads to double marginalization, and thus an equilibrium price higher than p_m, the one that would be charged by an integrated monopolist, the agency mode does not give distorted pricing incentives. To see the latter point formally, note that a change in α constitutes a proportional reduction in the publisher's *profits*, not just revenue, and thus the publisher never has an incentive to deviate from p_m (although, in this game's unique SPE, the distributor sets $\alpha = 1$, and thus, the publisher receives no profits).[1]

General graphical analysis. We now analyze the pricing incentives that arise more generally under the two modes. To do this, we appeal to a graphical representation, for each mode, that illustrates the price-quantity pair that arises in equilibrium. We now describe the "algorithm" one may use to draw such a graph for each mode.For each mode, begin by drawing the final inverse demand curve, $p(q)$, and the (straight) marginal cost curve, c. Then draw the "market marginal revenue curve," $MR(q) \equiv p(q) + qp'(q)$.

For wholesale mode, draw the "marginal revenue curve of the marginal revenue curve," $MMR(q) \equiv MR(q) + qMR'(q)$. Then, simply take the intersection of $MMR(q)$ and c to determine the equilibrium quantity, q_w^*. ($p_w \equiv p(q_w^*)$ is then the equilibrium price.) All curves in the wholesale mode are represented in Figure 6.1 below.

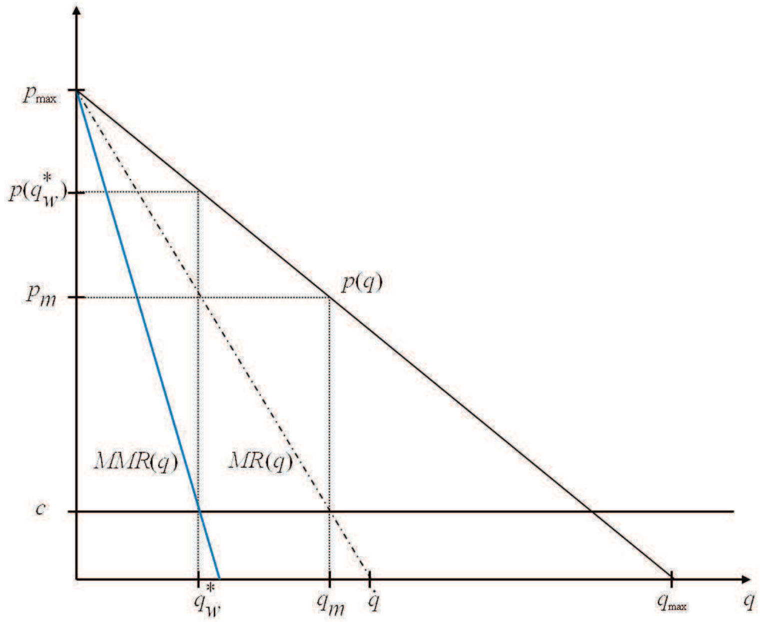


Figure 6.1: Equilibrium in the wholesale mode

For agency mode, first note that each candidate α causes a distinct degree

[1]When $c = 0$, agency mode closely resembles the "ultimatum game."

of rotation of the curves $p(q)$ and $MR(q)$, anchored, respectively, at the points $(q_{max}, 0)$ and $(\dot{q}, 0)$ (where $\dot{q}$ is formally defined by $MR(\dot{q}) = 0$). These rotated curves represent the inverse demand curve and the marginal revenue curve facing the publisher when it choses its price, given α (see the top graphic in Figure 6.2 below). Let $\overline{\alpha}$ denote the highest value of α such that, if the distributor sets it as such, the publisher cannot possibly earn positive profits (formally, let $\overline{\alpha}$ be defined implicitly by $(1 - \overline{\alpha})p(0) = c$).

For each $\alpha \in [0, \overline{\alpha}]$, find the intersection of the curve $(1-\alpha)MR(q)$ and c, as in the bottom-left graphic in Figure 6.2, and then for each q defined by this intersection, trace out the curve of "prices," $ISC(q) \equiv (1-\alpha(q))p(q)$. Define this curve as the *Input Supply Curve*. This name follows from the fact that it reflects the set of price-quantity pairs at which the distributor can "buy" products, under the interpretation that it "sells" them at some point along the *final* market demand curve. Next, draw the "Marginal Input Supply Curve," $MISC(q) \equiv ISC(q) + qISC'(q)$. To determine the equilibrium quantity, q_a^*, take the intersection of $MISC(q)$ and $MR(q)$, as in the bottom-right graphic in Figure 6.2. ($p_a \equiv p(q_a^*)$ is then the equilibrium price.)

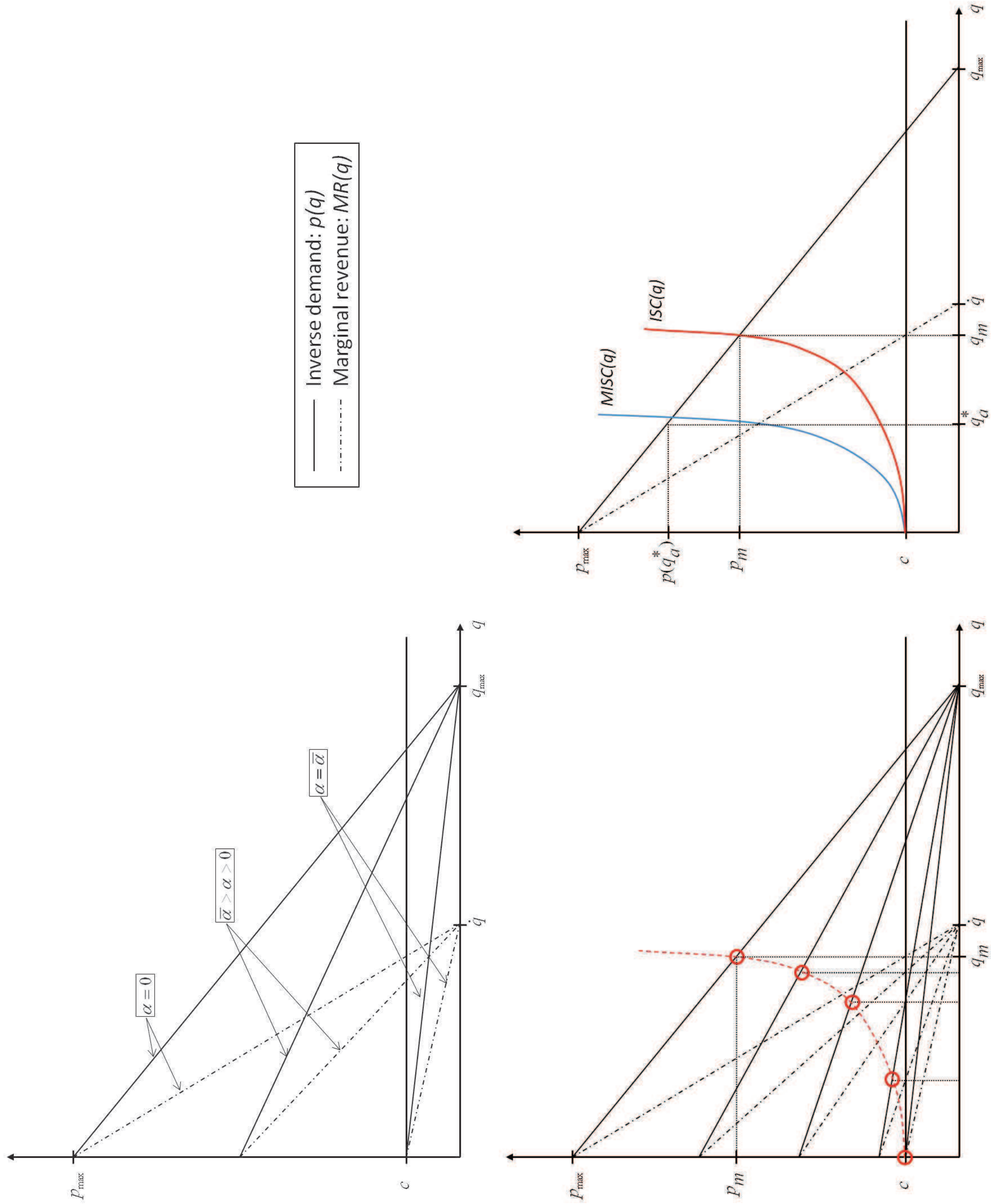


Figure 6.2: Equilibrium in the agency mode

Building on this representation of the two sales modes, we now turn to an analytical analysis.

6.2.4 Analytical results

We now determine necessary conditions for the retail equilibrium price in one mode to be greater than the price in the other mode. We use the variables defined previously.

We call $R(q) = p(q)q$ the revenue of an hypothetic integrated monopolist. We have the marginal revenue $MR(q) = p(q) + qp'(q)$, and its derivative $MR'(q) = 2p'(q) + qp''(q)$. Thus, we have in the wholesale mode: $MMR(q) = MR(q) + qMR'(q) = p(q) + 3qp'(q) + q^2p''(q)$.

In the agency mode, we know from the publisher's FOC that: $1 - \alpha = c/MR(q)$. Thus, $ISC(q) = cp(q)/MR(q)$, and $MISC(q) = ISC(q)+qISC'(q) = c(1 - R(q) * MR'(q)/MR^2(q))$. Finally, note that, from the second-order condition, we have, in any mode: $2p'(q) + qp''(q) < 0$. For exposition simplicity, we omit function arguments in the following when they are not necessary.

The equilibrium in the wholesale mode can be defined as the intersection of the MMR and c curves, or as the intersection of the MR and $c - qMR'$ curves. Indeed, as $MMR = MR + qMR'$, we have:

$$MMR = c \Leftrightarrow MR = c - qMR'. \tag{6.1}$$

Similarly, the equilibrium in the agency mode can be defined either as the intersection of the $MISC$ and MR curves, or the intersection of the marginal cost c and $MR^3/(MR^2 - R * MR')$ curves. This is so because $MISC = c(1 - R * MR'/MR^2)$, and, hence:

$$MISC = MR \Leftrightarrow c = \frac{MR^3}{MR^2 - R * MR'}. \tag{6.2}$$

We can thus use equilibrium functions that equal either marginal revenue or cost to compare both modes.

Let us focus on equilibrium functions that equal marginal cost. We compare $c_w(q) \equiv MR + qMR'$ and $c_a(q) \equiv MR^3/(MR^2 - R * MR')$. The two functions

$c_w(q)$ and $c_a(q)$ give the marginal costs in the wholesale and agency modes, respectively, for which the quantity q would be the equilibrium quantity in each mode. In equilibrium, the agency mode price p_a is lower than the wholesale mode price p_w when $c_a - c_w > 0$, and vice-versa. Indeed, $c_a - c_w > 0$ leads to a higher equilibrium quantity in the agency mode than in the wholesale mode. We have:

$$c_a - c_w = -MR' \left(q - \frac{R * MR}{MR^2 - R * MR'} \right). \tag{6.3}$$

Simple algebra shows that $c_a - c_w > 0$ is equivalent to:

$$\frac{qp'}{p} < 1 + \frac{qp''}{p'}, \tag{6.4}$$

First, note that both the slope of the inverse demand function and its curvature (or convexity), $-qp''/p'$, play a role in how equilibrium prices in both modes compare with each other.[1] Furthermore, as stated in Proposition 6.2 below, we see from inequality (6.4) that any concave demand function will lead to equilibrium prices in the agency mode that are lower than that in the wholesale mode. Indeed, concavity of demand is equivalent to $p'' < 0$, $\forall q$, and thus $1 + qp''/p' > 1$; additionally, we know that $qp'/p < 0$, so the inequality (6.4) is always verified.

Proposition 6.2. *In equilibrium, the agency mode retail price is lower than the wholesale mode retail price when the demand function is concave (i.e., when $p'' < 0$, $\forall q$).*

We can also express this condition over $c_a - c_w$ as a function of the pass-through rate dp/dc an hypothetical integrated monopolist would face; as with constant marginal costs we have:

$$\frac{dp}{dc} = \frac{1}{1 - \mu'} = \frac{1}{2 + \frac{qp''}{p'}}. \tag{6.5}$$

Therefore, $c_a - c_w > 0$ is equivalent to:

$$\frac{dp}{dc} < \frac{\epsilon}{\epsilon - 1} \Leftrightarrow \mu' < \frac{1}{\epsilon}, \tag{6.6}$$

[1] From a variable change, we find that inequality (6.4) expressed as a function of the variable p can be written as: $D(p)/(pD'(p)) < 1 - D(p)D''(p)/D'(p)^2$.

with $\epsilon = -p/q * \partial q/\partial p > 1$.

We can thus find whether the equilibrium price is lower in the wholesale mode or the agency mode by comparing the pass-through rate to the ratio $\epsilon/(\epsilon - 1)$, as expressed in Proposition 6.3 below.

Proposition 6.3. *When the pass-through rate is greater (resp., lower) than the ratio $\epsilon/(\epsilon - 1)$ for any positive quantity, the equilibrium price is lower (resp., higher) in the wholesale mode than in the agency mode.*

Finally, the inequality $c_a - c_w > 0$ is also equivalent to the ratio of marginal revenue over price being decreasing in the quantity. (This can also be expressed as the elasticity of demand being decreasing in the quantity, as $MR/p = 1 - 1/\epsilon$, with $\epsilon > 1$.) Indeed, $c_a - c_w > 0$ is also equivalent to:

$$\frac{\partial}{\partial q}\left(\frac{MR}{p}\right) < 0. \tag{6.7}$$

The latter formulation gives a straightforward graphical intuition: when the marginal revenue decreases more rapidly than the inverse demand over the range of interest such that the ratio MR/p decreases with the quantity, the equilibrium price in the agency mode is lower than that in the wholesale mode.

While the above analysis leads to straightforward results regarding the equilibrium price level in both modes, it is limited in that it is only a local comparison between the functions c_a and c_w. (Propositions 6.2 and 6.3 are direct translations of local results to global conditions.) As these two functions could well intersect several times, we need to restrict our analysis to simple results over global conditions that allow us to determine which mode leads to a lower equilibrium price for any marginal cost. Below, we first study in details these global conditions when c_a and c_w never cross. Then we provide an example where c_a and c_w cross at least once. We leave the analysis of more complicated demand functions which would lead to the functions c_a and c_w to cross once or several times for future research.

6.2.4.1 Global conditions 1: $c_a(q)$ and $c_w(q)$ never cross

As we can only determine whether the retail price is lower or higher in one mode than the other when the sign of $c_a - c_w$ does not change over the range of interest, let us first consider below some precise cases where c_a and c_w never intersect.

In this case, we have that $c_a - c_w > 0$, and thus the equilibrium price is lower in the agency mode, for any marginal cost. This is straightforward from the graphical analysis when using inequality (6.7), as marginal revenue equals price when $q = 0$ and the MR curve is below the inverse demand curve at any positive quantity, until it crosses the horizontal axis at $\dot{q}$ (we have $MR(\dot{q}) = 0$, by definition). This shows that, we always have $c_a - c_w \geq 0$ globally on the interval defined by $q \in [0, \dot{q}]$, regardless of how many times the two functions intersect, as $MR(\dot{q})/p(\dot{q}) - MR(0)/p(0) = -1 < 0$.[1] Thus, when they never cross, $c_a - c_w > 0$ is actually satisfied at the local level for each and every quantity.

Log-concavity. Using inequality (6.6), we can easily verify that the equilibrium price in the agency mode is lower than that in the wholesale mode for a wide class of functions. Indeed, as explained by Weyl and Fabinger [2013], any log-concave demand gives $dp/dc < 1$, and, thus, induces a lower equilibrium price in the agency mode than in the wholesale mode, as $\epsilon > 1$.[2] For instance, any linear demand function gives a pass-through rate of 1/2, and, hence, leads to $p_a < p_w$. This result is summarized in Proposition 6.4 below.

Proposition 6.4. *Log-concave demand forms induce equilibrium retail prices to be higher in the wholesale mode than in the agency mode.*

Constant pass-through. The price comparison between both modes is also straightforward when we study demand functions with a constant pass-through $dp/dc = 1/(1 - \mu')$. In a recent working paper, Fabinger and Weyl [2012] show that constant pass-through demand functions can be expressed as:

$$D(p) = \sigma \left[1 + \frac{\mu'}{1 - \mu'} \frac{p}{m} \right]^{\frac{-1}{\mu'}}, \tag{6.8}$$

[1]It can be the case that the inverse demand function follows a vertical asymptote when $q \longmapsto 0$ and/or an horizontal one when $\dot{q} \longmapsto \infty$. In these cases, we have $\lim_{q \longmapsto 0} MR(q) = p$ and $\lim_{q \longmapsto \dot{q}} MR(q) = 0$. Thus, we have $\lim_{q \longmapsto \dot{q}} MR(q)/p(q) - \lim_{q \longmapsto 0} MR(q)/p(q) = -1 < 0$, and $c_a - c_w$ is globally negative on the interval $(0, \dot{q})$.

[2]Log-concavity of demand is equivalent to $0 \leq 1 + qp''/p'$.

with $\sigma > 0$, $m > 0$, and $\mu' < 1$. Calculating the elasticity of demand, we obtain that:

$$\frac{1}{\epsilon} = \mu' + \frac{m(1-\mu')}{p}. \tag{6.9}$$

Thus, as the second term in the right-hand side of equation (6.9) is positive, we can see that $1/\epsilon$ is greater than (or equal to) μ'. Therefore, the equilibrium price is lower in the agency mode than that in the wholesale mode from inequality (6.6), as stated in Proposition 6.5 below.

Proposition 6.5. *The equilibrium retail price in the agency mode is lower than (or equal to) that in the wholesale mode when the demand function has a constant pass-through.*

A special result occurs when $m \longmapsto 0$, or $\mu' \longmapsto 1$. In these cases which define constant-elasticity demand forms, we have $1/\epsilon \longmapsto \mu'$ from equation (6.9), and prices are equal in both modes as shown in Subsection 6.2.2. Furthermore, writing the pass-through rate as a function of the elasticity of demand as in Bulow and Pfleiderer [1983], that is $dp/dc = \epsilon/(\epsilon - 1 + (p/\epsilon) * d\epsilon/dp)$, we see that the equilibrium price in the wholesale mode equals the equilibrium price in the agency mode only when $d\epsilon/dp = 0$.[1] Hence, both equilibrium retail prices are equal, for any marginal cost, *only* for constant-elasticity demand functions, as expressed in Proposition 6.6 below. (Note that, with constant-elasticity demand and a marginal cost close to zero, the equilibrium quantity goes toward infinity in both modes.)

Proposition 6.6. *Constant-elasticity demand functions are the only demand forms for which retail prices in the wholesale and in the agency mode are equal for any marginal cost, in equilibrium.*

6.2.4.2 Global conditions 2: $c_a(q)$ and $c_w(q)$ cross at least once

As explained above, we always have $c_a - c_w \geq 0$ globally on the interval $[0, \dot{q}]$ (or $(0, \dot{q})$), regardless of how many times the two functions c_a and c_w intersect. When they do intersect at least once, we know that the equilibrium price in the wholesale mode is lower than that in the agency mode for the range over which $c_a - c_w < 0$.

[1] Constant-elasticity demand functions have a pass-through equal to $dp/dc = \epsilon/(\epsilon - 1)$.

Using the adjustable pass-through (Apt) demand function defined by Fabinger and Weyl [2012], we can determine demand functions such that the equilibrium price in the wholesale mode, p_w, is lower than that in the agency mode, p_a. For instance, the Apt demand with parameters $\overline{\mu'} = 0.7$, $\alpha = 2$, $m = 0.01$, and $\sigma = 0.5$, leads to $c_a - c_w < 0$, and thus to $p_w < p_a$, for any constant marginal cost above 0.019. (For marginal costs below this threshold we have that $c_a - c_w$ is positive, so $p_a < p_w$.)

6.2.5 Discussion

In this section, we have done three things. First, we have defined two versions of a game that represent, respectively, wholesale and agency contracting arrangements. Second, we have shown that when demand is of the constant elasticity form, the two arrangements lead to the same equilibrium price. Third, we have illustrated that, on the one hand, when demand is relatively concave, the standard intuition holds, whereby wholesale pricing leads to higher prices due to double marginalization. On the other hand, when demand is sufficiently convex and marginal costs not too small, then agency pricing leads to higher prices than wholesale.

While this analysis constitutes one mechanism that could have led ebook prices to increase when the industry switched from using wholesale to using agency contracts, it is certainly an open question whether the demand for books is typically of the form that would be consistent with such a mechanism. Given that each book can reasonably thought of as having its own “locally monopolistic” demand curve, it is very likely that some books have demand curves that, according to this sections model, would lead the equilibrium price to increase after the shift of contracting modes whereas others have demand curves that would lead the price to decrease. An interesting idea for future research would be to estimate the demand for a large set of ebooks using the Apt specification and test whether, following the change in contracting modes, the subsequent changes in their prices are consistent with this model’s prediction.

We now extend the model to include the sale of access devices, and study the interaction between their presence and the shift between contracting arrangements.

6.3 Model with access device sales

In this section, we develop a very stylized model in a context in which there are two types of goods sold by firms: variable goods (ebooks) and access devices (ereaders). It shows that when firms switch from the wholesale mode to the agency mode, we can simultaneously observe an increase in variable good prices and a decrease in access device prices.[1] As a result, a deeper analysis is needed in order to draw some conclusions of this switch from one mode to another on welfare or consumer surplus.

In the remainder of this paper, and in contrast to Section 6.2, we do not endogenize the contract terms w (the wholesale price in the wholesale mode) or α (the revenue share in the agency mode). Doing so allows us to study a wider range of contract terms, which possibly result from negotiation on the contract terms in the first step. Also, considering w or α as parameters rather than endogenous variables makes the analysis more tractable.

6.3.1 Firms and contracts

There are two firms in the industry, each of them operating as a monopolist in one of two vertically-related markets.[2] The publisher sells variable goods to the distributor, through a wholesale or an agency contract. With a wholesale contract, the distributor buys each good at price w and is free to set the price paid by consumers. By contrast, with an agency contract, and the retail price p is set by the publisher, and the distributor earns a share α of revenue from the variable good sales.

The distributor also sells an access device (ereaders) to consumers at price T. Buying an access device is a prerequisite for consumers in order to buy the variable goods; and consumers make a discrete choice of buying the device. For instance, in the ebook industry, a consumer is unable to read an ebook without a reading device to do so; and distributors such as Apple or Amazon which resell

[1]The price of Amazon's Kindle has significantly dropped over the past few years. However, it is hard to disentangle the effect we highlight in this paper from the results of competition or cost reduction.

[2]While these vertically-related markets actually are oligopolistic (with five or six major book publishers, and two major distributors), we focus on the monopoly case in order to understand precisely the role of access devices in the market.

ebooks through their online stores also are the biggest ereader manufacturers (with the iPad and the Kindle, respectively). Similarly, in the telephony industry, consumers need a phone to be connected to the network in order to buy minutes of calls.

We assume that variable goods and access devices have constant marginal costs, c and K, respectively.

6.3.2 Consumers

Consumers are of bi-dimensional types. Consumer i is characterized by her valuation for the access device $x_i \in x$ and her taste for variable goods $b_i \in b$. In the ebook case, access devices are tablets or ereaders, that consumers effectively value on their own, as they can use them to download free ebooks (such as public domain ebooks) or applications, to browse the internet, to watch movies, etc. Variable goods are ebooks, or applications, that consumers might read on their device. Similarly, in the telephony industry, consumer subscribe to telephony offers not only to make some calls, but also because they value the connection to the network, through which they can receive calls from other consumers.

As consumers are heterogeneous in both types x and b, our analysis corresponds to a generalized version of Schmalensee [1981], with consumers also valuating 'access' to the variable good. We call a consumer who buys the access device a "participating consumer."

A participating consumer i has a gross utility $V(b_i, q)$ of consuming q variable goods. Assume $\partial V/\partial q > 0$ and $\partial^2 V/\partial q^2 < 0$, so the marginal utility of consuming a variable good is positive and decreasing in the number of goods a consumer purchases. Assume also that $V(b_i, q)$ is increasing in b_i.

Therefore, consumer i's net utility is:

$$u(b_i, x_i, p, T) = x_i + V(b_i, q) - pq - T. \tag{6.10}$$

We call $q(p, b_i)$ the number of variable goods a participating consumer buys, given her type b_i and the price p. $q(p, b_i)$ is decreasing in price p and increasing in type b_i. A consumer with types (x_i, b_i) would like to maximize her net utility by choosing the number of variable goods $q = q(p, b_i)$ she buys, given prices p and

T:

$$
\begin{aligned}
q(p, b_i) &= \arg\max_q(u(b_i, x_i, p, T)) = \arg\max_q(V(b_i, q) - pq),\\
q(p, b_i) &= q \text{ s.t. } \tfrac{\partial}{\partial q}(x_i + V(b_i, q) - pq - T) = 0, \qquad (6.11)\\
q(p, b_i) &= q \text{ s.t. } p = \tfrac{\partial V(b_i, q)}{\partial q},
\end{aligned}
$$

with the condition that $q \geq 0$.

6.3.3 Timing

We assume that both firms have negotiated and set the contract terms (i.e, w, or α) before the beginning of the game. Hence, we take the contract terms as given parameters in this analysis so far. The timing is as follows:

1. First, firms set their retail prices simultaneously.

2. Then, consumers purchase the product.

We assume that both retail prices, for the variable goods and the access devices, are set simultaneously. We think this is a good approximation because both ebooks and ereaders are durable goods.[1] Another reason why we use simultaneous pricing is that we do not want to introduce other effects due to sequential pricing when we compare both modes.

6.3.4 The model

We call $f(x, b)$ the probability density function. We define $\hat{x}(p, T, b_i)$ as the device valuation of a marginal consumer with taste for variable goods b_i, at prices p and T. We have:

$$
\begin{aligned}
\hat{x}(p, T, b_i) &= x_i \text{ s.t. } u(b_i, x_i, p, T) = 0,\\
\hat{x}(p, T, b_i) &= T - V(q(p, b_i), b_i) + pq(p, b_i).
\end{aligned} \qquad (6.12)
$$

As $x_i \in (-\infty, +\infty)$, we know that $\hat{x}(p, T, b_i)$ exists for any p, T and b_i. We also have $\partial\hat{x}(p, T, b_i)/\partial T = 1$, and $\partial\hat{x}(p, T, b_i)/\partial p = q(p, b_i)$.

[1] By contrast, Gans [2012] argues that ereaders or tablets are durable goods, whereas ebooks or applications are not. (One can also see ereaders as 'more' durable goods than ebooks.) Thus, in his analysis, ebook or application publishers can adjust their prices after the distributor has set the access device price.

Furthermore, we define N as the number of participating consumers, that is, the number of consumers who buy an access device. We have:

$$N \equiv \int_{-\infty}^{+\infty} \int_{\hat{x}(p,T,z)}^{+\infty} f(y,z)dydz. \tag{6.13}$$

Similarly, we define Q as the total number of variable goods sold, according to the following formula:

$$Q \equiv \int_{-\infty}^{+\infty} \int_{\hat{x}(p,T,z)}^{+\infty} q(p,z)f(y,z)dydz. \tag{6.14}$$

Finally, we call M the number of marginal consumers for given prices p and T; that is all consumers with $u(b_i, x_i, p, T) = 0$. (As the consumer type is bi-dimensional, there exist several marginal consumer types for given prices.) We have:

$$M \equiv \int_{-\infty}^{+\infty} f(\hat{x}(p,T,z), z)dz. \tag{6.15}$$

We also use the following notations:

- We use an 'upper-line' over a variable in order to represent the inframarginal consumers' average valuation of this variable; that is, $\overline{X} \equiv \mathbb{E}[X \mid u_i \geq 0]$, $\forall X$.
- We use a 'tilde' over a variable in order to represent the marginal consumers' average valuation of this variable; that is, $\widetilde{X} \equiv \mathbb{E}[X \mid u_i = 0]$, $\forall X$.

Therefore, with our newly defined variables and notations, we can write down the derivatives of our main variables with respect to retail prices p and T. We obtain:

- $N_T = \partial N / \partial T = -M$;
- $N_p = \partial N / \partial p = -M\mathbb{E}[q \mid u_i = 0] = -M\widetilde{q}$;
- $Q_T = \partial Q / \partial T = -M\mathbb{E}[q \mid u_i = 0] = -M\widetilde{q}$;
- $Q_p = \partial Q / \partial p = -M\mathbb{E}[q^2 \mid u_i = 0] + \sigma = -M\widetilde{q^2} + \sigma$, where $\sigma \equiv N\overline{\frac{\partial q}{\partial p}}$ is the inframarginal substitution effect, which is negative.

From the derivatives, we see that all marginal consumers stop consuming when the price of access devices T increases, whereas only marginal consumers who bought a strictly positive number of variable goods stop consuming when the price of variable goods p increases.

6.3.5 An example

In order to understand why such analysis is necessary to assert welfare effects of a switch from one mode to another, let us focus on a simple example with precise demand forms, before turning to a more general model in the following subsections.

Assume that consumer i, of type (x_i, b_i), has a valuation $x_i \in [0, 1]$ for the access device, which is drawn from a uniform probability density function. Additionally, consumer i has a gross utility $V(b_i, q) = b_i\sqrt{q}$ from purchasing q variable goods. We assume that $b_i \in [0, 1]$ and is drawn from a uniform probability density function. Finally, assume that consumers are uniformly distributed in both dimensions, and we normalize the total number of consumers to 1.

From Roy's identity, we know that consumer i buys $q_i = b_i^2/(4p^2)$ variable goods at total price pq_i in equilibrium in order to maximize $V(b_i, q) - pq$. Hence, the net utility of purchasing the access device and variable goods for consumer i is:

$$u(b_i, x_i, p, T) = x_i - T + V(b_i, q_i) - pq_i = x_i - T + \frac{b_i^2}{4p}. \tag{6.16}$$

For any given b_i, $\hat{x}(p, T, b_i)$ is the access device valuation which defines a marginal consumer with variable good type b_i. As marginal consumers are defined by zero utility from purchasing, we have, from equation (6.16):

$$\hat{x}(p, T, b_i) = T - \frac{b_i^2}{4p}. \tag{6.17}$$

We can now determine the total number of participating consumers N in equilibrium, i.e., those who buy an access device, as well as the total number of variable goods sold, Q. We obtain, from equations (6.13) and(6.14):

$$\begin{cases} N = & 1 - T + \dfrac{1}{12p}, \\ Q = & \dfrac{1-T}{12p^2} + \dfrac{1}{80p^3}. \end{cases} \tag{6.18}$$

We can thus write down the profit functions and the FOCs in both the wholesale and the agency modes.

6.3.5.1 Wholesale mode - Example

In the wholesale mode, the distributor sets both price p and T. Its profit function is:

$$\pi_D(p, T) = (p - w)Q + (T - K)N. \tag{6.19}$$

By contrast, the publisher earns $\pi_P = (w - c)Q$. Note that we consider w as a parameter in this analysis. From the distributor's profit function, we obtain the FOCs:

$$\begin{cases} 0 = & \dfrac{\partial \pi_D}{\partial p} & = & Q + (p - w)Q_p + (T - K)N_p, \\ 0 = & \dfrac{\partial \pi_D}{\partial T} & = & N + (p - w)Q_T + (T - K)N_T, \end{cases} \tag{6.20}$$

with $N_T = -1$, $N_p = -1/(12p^2)$, $Q_T = -1/(12p^2)$, and $Q_p = -(1 - T)/(6p^3) - 3/(80p^4)$, from the equation system (6.18).

6.3.5.2 Agency mode - Example

In the agency mode, the distributor sets the access device price T, whereas the publisher sets the variable good price p. The profit function of the publisher is:

$$\pi_P(p) = [(1 - \alpha)p - c]\, Q; \tag{6.21}$$

and the profit function of the distributor is:

$$\pi_D(T) = \alpha p Q + (T - K)N. \tag{6.22}$$

The FOCs are:

$$\begin{cases} 0 = & \dfrac{\partial \pi_P}{\partial p} = & (1-\alpha)Q + [(1-\alpha)p - c]\, Q_p, \\ 0 = & \dfrac{\partial \pi_D}{\partial T} = & N + (T-K)N_T + \alpha p Q_T, \end{cases} \tag{6.23}$$

with, from the equation system (6.18): $N_T = -1$, $Q_T = -1/(12p^2)$, and $Q_p = -(1-T)/(6p^3) - 3/(80p^4)$.

6.3.5.3 Comparative statics - Example

We can then solve numerically the equation systems given by the FOCs in both modes, focusing on interior solutions.[1]

Figure 6.3 below compares retail prices in the wholesale and agency modes, both for variable goods and access devices, as functions of the wholesale mark-up $w-c$ and the revenue share α, for marginal cost values of $c = 0.07$, and $K = 0.2$. (These marginal costs ensure the interior solution exists for any $w - c \in [0, 1)$ and any $\alpha \in [0, 1)$.)

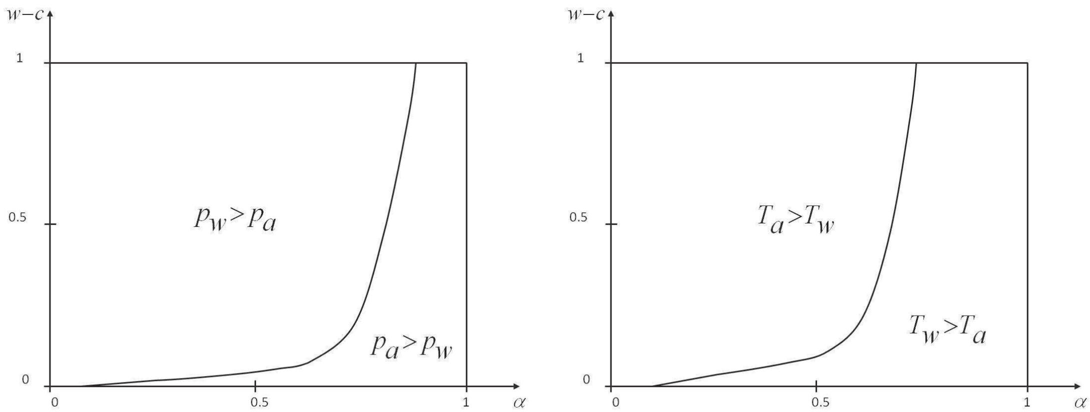


Figure 6.3: Prices in the wholesale and the agency modes ($c = 0.07$, and $K = 0.2$)

The left graphic of Figure 6.3 shows the outcome of the comparison between variable good prices in the wholesale and the agency modes. We see that when the share of revenue α kept by the distributor is high, the price of variable goods

[1] We focus on numerical solutions because we just want to highlight the relationship between the prices of variable goods and access devices. We derive analytical (implicit) solutions from the FOCs without using any particular demand form in Section 6.3.

in the agency mode is higher than in the wholesale mode. For medium values of α, this price is higher in the agency mode when the wholesale price is close to the variable good marginal cost in the wholesale mode (that is, when $w - c$ is close to zero).

The right graphic of Figure 6.3 represent the comparison between the prices of access devices in both modes. It shows that for low α, the price in the agency mode is above the price in the wholesale mode, but for low mark-ups in the wholesale price w. However, when the distributor keeps a high share of revenues from variable good sales, the access device price is higher in the wholesale mode than in the agency mode.

We see from Figure 6.3 that when α is high enough (above 0.16 in our example), any increase in the price of variable goods that follows a shift from the wholesale mode to the agency mode occurs in conjunction with a decrease in the price of access devices. Therefore, changes in welfare or consumer surplus that follow the transition from one mode to another are not straightforward and should not be analyzed upon changes in the variable good price only.

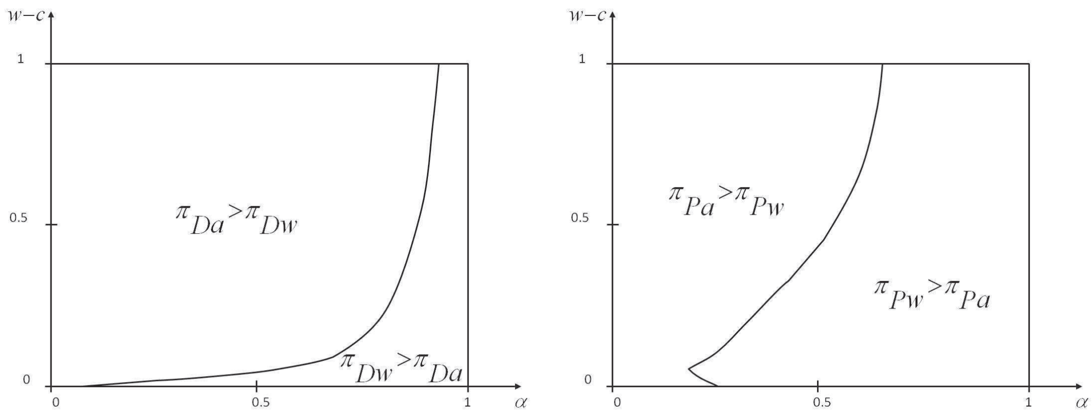


Figure 6.4: Distributor's profit (left) and publisher's profit (right) in the wholesale and the agency modes ($c = 0.07$, and $K = 0.2$)

Figures 6.4 and 6.5 represent the comparisons between firms' profits and welfare and consumer surplus, respectively, in both modes. We see from these figures that a higher variable good price in the wholesale mode than in the agency mode almost always induces higher distributor's profit, consumer surplus, and welfare in the agency mode than that in the wholesale mode. Therefore, in our example, a price increase resulting from a switch from the wholesale to the agency mode

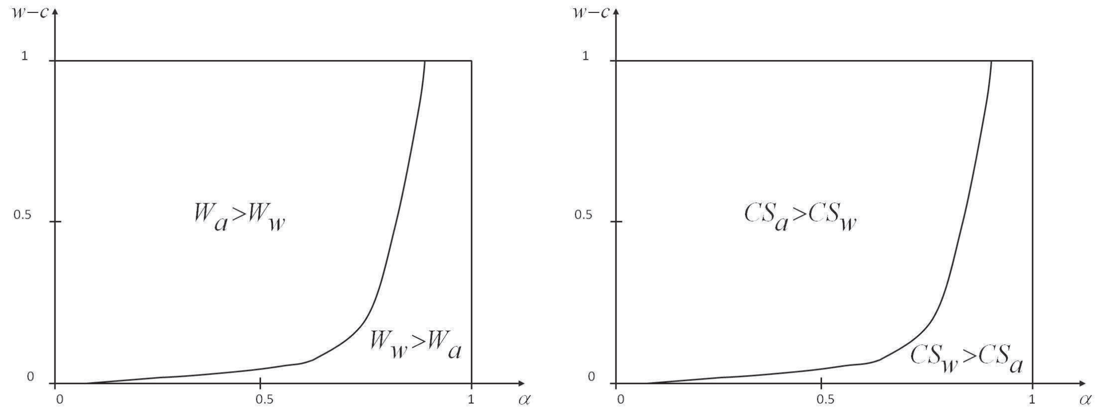


Figure 6.5: Welfare and consumer surplus in the wholesale and the agency modes ($c = 0.07$, and $K = 0.2$)

in the variable good market almost always indicates a decrease in welfare and consumer surplus.[1] In this case, requiring both firms to contract according to the wholesale mode, as did the DOJ in the ebook antitrust case, is almost always welfare improving.

This example indicates that a deep economic analysis is necessary to understand the impact of switching from one mode to another. To this end, we provide a general characterization of equilibrium outcomes in both wholesale and agency modes with access device sales in the following. In contrast to the above example, we do not use any particular demand forms.

6.3.6 Wholesale mode - General case

We now determine the optimal two-part tariff with heterogeneous participation in the wholesale mode. In this mode, the distributor earns $p - w$ for each sold variable good and $T - K$ for each sold access device. It's profit function is:

$$\pi_D(p, T) = (p - w)Q + (T - K)N. \tag{6.24}$$

By contrast, the publisher earns $\pi_P = (w - c)Q$. Note that we consider w as

[1]The correlation between having a lower variable good price in the agency mode and a higher welfare in the same mode equals 0.944 in our example.

a parameter in this analysis. We have the FOCs:

$$\begin{cases} 0 = & \dfrac{\partial \pi_D}{\partial p} = & Q + (p-w)Q_p + (T-K)N_p, \\ 0 = & \dfrac{\partial \pi_D}{\partial T} = & N + (p-w)Q_T + (T-K)N_T. \end{cases} \tag{6.25}$$

Noting that $Q = N\overline{q}$, we obtain:

$$\begin{cases} 0 = & N\overline{q} + (p-w)\sigma - (p-w)M\widetilde{q^2} - (T-K)M\widetilde{q}, \\ 0 = & N - (p-w)M\widetilde{q} - (T-K)M. \end{cases} \tag{6.26}$$

Finally, we can determine the equilibrium prices.

Proposition 6.7. *In the wholesale mode, the equilibrium prices are:*

$$\begin{cases} p = & w + \dfrac{N}{M\left(\widetilde{q^2} - \widetilde{q}^2\right) - \sigma}\left(\overline{q} - \widetilde{q}\right), \\ T = & K + \dfrac{N}{M\left(\widetilde{q^2} - \widetilde{q}^2\right) - \sigma}\left(\widetilde{q^2} - \overline{q}\widetilde{q} - \dfrac{\sigma}{M}\right). \end{cases} \tag{6.27}$$

As there is more than one type of marginal consumers, which differs to the standard case where consumers only differ in type b_i,[1] the variance of variable good consumption by marginal consumers, $\mathrm{Var}(q \mid u = 0) = \widetilde{q^2} - \widetilde{q}^2$, is strictly positive. This is so because consumers at the margin do not all buy the same number of variable goods. By contrast, in the one-type case we have $\widetilde{q^2} = \widetilde{q}^2$, as the number of variable goods bought is constant within the set of marginal consumers.

This additional term, $\mathrm{Var}(q \mid u = 0)$, precisely comes from the fact that the distributor takes into account its own profit loss in the access device market due to an increase in the price of variable goods when setting both prices.

We can rearrange the first equation in the equation system (6.27) to obtain:

$$\frac{p-w}{p} = \frac{1}{\overline{\epsilon}^p}\left(1 - \frac{\widetilde{q}}{\overline{q}}\right), \tag{6.28}$$

with $\overline{\epsilon}^p = -\overline{q}_p(p/Q) = -(Q_p - (N_p/N_T)Q_T)(p/Q)$, as in Schmalensee [1981];

[1] See, e.g., Oi [1971], Schmalensee [1981], and the reviews by Varian [1989], and Wilson [1997].

where $\overline{q}_p$ is the compensated derivative of Q with respect to p, with T adjusted so as to hold N constant. In our bi-dimensional setting, we have $\overline{\epsilon}^p = (M\mathrm{Var}(q \mid u = 0) - \sigma)(p/Q)$.[1]

This result also relates to Rochet and Stole [2002].[2] They introduce an 'outside opportunity cost' in the classic Mussa-Rosen framework. In their paper, consumers' type is bi-dimensional, in the quality-valuation and in this opportunity cost. This opportunity cost corresponds to the inverse of consumer i's valuation for the access device in our framework, i.e., to $-x_i$. Note that, however, Rochet and Stole [2002] do not study the impact of vertical relations and different types of contracts in their paper.

From the top line in the equation system (6.27), we can see that $p - w$ always has the same sign than $\overline{q} - \widetilde{q}$, as in the one-dimension two-part tariff in Schmalensee [1981]. However, we can give new insights on the sign of $T - K$. First, when all consumers are identical in their variable good consumption, i.e., when $\overline{q} = \widetilde{q}$, the variable good is priced at the wholesale price w and the access device is priced above cost, as explained by Oi [1971]. Second, when the average variable good consumption is larger for marginal than for inframarginal consumers (i.e., when $\overline{q} < \widetilde{q}$), the variable good is priced below the wholesale price, and profit is earned by the distributor through an above-cost access device price; i.e., $T - K > 0$, as in Schmalensee [1981]. Finally, when the average consumer buys more variable goods than the average marginal consumer (i.e., $\overline{q} > \widetilde{q}$), the sign of $T - K$ is generally ambiguous, as in Schmalensee [1981], only if $\widetilde{q^2} < \overline{q}\widetilde{q}$. By contrast, when $\widetilde{q^2} > \overline{q}\widetilde{q}$, there is no ambiguity and the price of access devices is above marginal cost, i.e., $T - K > 0$. The latter case can occur only in our framework, because we have different marginal consumer types, and this can allow for $\overline{q} > \widetilde{q}$ and $\widetilde{q^2} > \overline{q}\widetilde{q}$ simultaneously.

These results are summarized in Proposition 6.8 below.

Proposition 6.8. *In the wholesale mode,* $(p - w)$ *has the sign of* $(\overline{q} - \widetilde{q})$*; and* $(T - K) > 0$ *when (i)* $\overline{q} = \widetilde{q}$*, when (ii)* $\overline{q} < \widetilde{q}$*, or when (iii)* $\overline{q} > \widetilde{q}$ *and* $\widetilde{q^2} > \overline{q}\widetilde{q}$*.*

[1] See also the paper by Veiga and Weyl [2012], where the authors generalize monopoly pricing when consumers have multi-dimensional heterogeneity. They find that the term including this variance is responsible for a *sorting effect*, which translates changes in the firm's attributes into changes in the consumer's population, keeping the overall number of consumers constant.

[2] See also Rochet and Stole [1997] for an extended analysis.

If we implement the optimal prices from the equation system (6.27) in the firms' profit functions, we obtain:

$$\begin{cases} \pi_P^* = & (w-c)N\overline{q}, \\ \pi_D^* = & \dfrac{N^2}{M\left(\widetilde{q^2}-\widetilde{q}^2\right)-\sigma}\left[(\overline{q}-\widetilde{q})^2+\left(\widetilde{q^2}-\widetilde{q}^2\right)-\dfrac{\sigma}{M}\right]. \end{cases} \tag{6.29}$$

Homogeneity in access valuation. Our analysis encompasses the case where consumers are homogeneous in their valuation for the access devices and only differ in their valuation for variable goods, i.e., $x_i = x$, $\forall i$. In this case, the analysis is similar to the one for setting a two-part tariff when the consumers have $x = 0$, as studied by Oi [1971] or Schmalensee [1981]. Indeed, there is only one type of marginal consumers, and we have $\widetilde{q}^2 = \widetilde{q^2}$, and, hence, $\text{Var}(q \mid u = 0) = \widetilde{q^2} - \widetilde{q}^2 = 0$.

We obtain, similarly to equations (15) and (16) in Schmalensee [1981]:[1]

$$\begin{cases} p - w = & \dfrac{N}{-\sigma}\left(\overline{q}-\widetilde{q}\right), \\ T - K = & \dfrac{N}{-\sigma}\left(\widetilde{q}^2-\overline{q}\widetilde{q}-\dfrac{\sigma}{M}\right). \end{cases} \tag{6.30}$$

Welfare analysis. We can also study total welfare, in order to find the optimal price a benevolent planner would set, and how much profit-maximization diverges from the social optimum. We have the welfare function:

$$W = \int_{-\infty}^{+\infty}\int_{\hat{x}(p,T,z)}^{+\infty}(y + V(q(p,z),z) - pq(p,z) + (p-c)q(p,z) - K)f(y,z)dydz \tag{6.31}$$

Using Roy's identity and the definition of $\hat{x}$ we obtain:

$$\begin{cases} \dfrac{\partial W}{\partial p} = & -M\widetilde{q}(T-K) - M\widetilde{q^2}(p-c) + (p-c)\sigma, \\ \dfrac{\partial W}{\partial T} = & -M(T-K) - M\widetilde{q}(p-c). \end{cases} \tag{6.32}$$

Note from the second line in the equation system (6.32) that there is no infra-marginal welfare effect from an increase in the access device price T, because the

[1] Note that there is a sign inversion in Schmalensee [1981], equation (16).

this would simply be a transfer from consumers to the distributor.

As straightforward question is then: in our framework, does marginal cost pricing allow for welfare maximization? We can write down the FOCs to answer this question:

$$\begin{cases} \dfrac{\partial W}{\partial p} & = & 0, \\ \dfrac{\partial W}{\partial T} & = & 0. \end{cases} \tag{6.33}$$

We obtain:

$$\begin{cases} (T-K) & = -\widetilde{q}(p-c), \\ 0 & = \left[M\left(\widetilde{q^2}-\widetilde{q}^2\right)-\sigma\right](p-c). \end{cases} \tag{6.34}$$

The second equation in the system of equations (6.34) shows us that either $p = c$ or $M(\widetilde{q^2} - \widetilde{q}^2) - \sigma = 0$ at the social optimum. Therefore, when the variable good is sold at the marginal cost (i.e., $p = c$), and, from the top line in the equation system (6.34), the access device is also sold at marginal cost, the social optimum is obtained. In this case, marginal cost pricing for both products is welfare maximizing. Note that this result is an extension of what is already known from the literature when consumers do not value the access device (see Varian [1989], section 2.2.4, p. 610). This result is summarized in Proposition 6.9 below.

Proposition 6.9. *The social optimum is obtained with marginal cost pricing for both types of products.*

Instead, when $M(\widetilde{q^2} - \widetilde{q}^2) - \sigma = 0$, we obtain different results. As $M(\widetilde{q^2} - \widetilde{q}^2)$ and $-\sigma$ are positive, the above equality occurs if and only if $\widetilde{q^2} - \widetilde{q}^2 = 0$ and $\sigma = 0$ simultaneously. The first equality tells us that, at the margin, all consumers buy the same number of variable goods, i.e. $\widetilde{q^2} = \widetilde{q}^2$, and the second equality tells us that the inframarginal demand is inelastic. Hence, when the inframarginal demand is inelastic and all consumers buy q variable goods, welfare maximization can be obtained without marginal cost pricing and $(T - K)$ has an opposite sign to $(p - c)$, or is equal to zero if $q = 0$.

6.3.7 Agency mode - General case

We now turn to analyzing the optimal retail prices in the agency mode. Recall that in this mode the publisher sets the variable good price whereas the distributor only sets the device price. Also, both prices are set simultaneously, and α is the share of revenues that is captured by the distributor. We assume that both firms earn a positive share of revenues from the variable good sales, that is, $\alpha \in (0,1)$.

The profit function of the publisher is:

$$\pi_P(p) = [(1-\alpha)p - c]\, Q; \tag{6.35}$$

and the profit function of the distributor is:

$$\pi_D(T) = \alpha p Q + (T-K)N. \tag{6.36}$$

We have the FOCs:

$$\begin{cases} 0 = & \dfrac{\partial \pi_P}{\partial p} = & (1-\alpha)Q + [(1-\alpha)p - c]\, Q_p, \\ 0 = & \dfrac{\partial \pi_D}{\partial T} = & N + (T-K)N_T + \alpha p Q_T. \end{cases} \tag{6.37}$$

Solving this equation system, we obtain:

$$\begin{cases} 0 = & N\overline{q} + \left(p - \dfrac{c}{1-\alpha}\right)\sigma - \left(p - \dfrac{c}{1-\alpha}\right) M\widetilde{q^2}, \\ 0 = & N - \alpha p M\widetilde{q} - (T-K)M. \end{cases} \tag{6.38}$$

Finally, we can determine the equilibrium prices.

Proposition 6.10. *In the agency mode, the equilibrium prices are:*

$$\begin{cases} p = & \dfrac{c}{1-\alpha} + \dfrac{N}{M\widetilde{q^2} - \sigma}\overline{q}, \\ T = & K + \dfrac{N}{M\widetilde{q^2} - \sigma}\left(\widetilde{q^2} - \alpha\overline{q}\widetilde{q} - \dfrac{\sigma}{M}\right) - \dfrac{\alpha c}{1-\alpha}\widetilde{q}. \end{cases} \tag{6.39}$$

In contrast to the results obtained for the wholesale case, the equilibrium prices do not depend on the variance in consumption of the variable goods by marginal consumers. This is so because the publisher does not take into account the distributor's profit loss in the access device market due to an increase in the price of variable goods, with the agency contract.

Note that the publisher's price for variable goods p is always above cost when agency contracts are used. By contrast, the price set by the distributor for the access device might be below or above cost. This is so because the distributor might push demand by setting a low price for access device, thus earning large revenues through the sale of variable goods.

If we implement the optimal prices from the equation system (6.39) in the publisher's and the distributor's profit functions in equations (6.35) and (6.36), respectively, we obtain:

$$\begin{cases} \pi_P^* = & (1-\alpha)\dfrac{N^2\overline{q}^2}{M\widetilde{q}^2-\sigma}, \\ \pi_D^* = & \dfrac{N^2}{M\widetilde{q}^2-\sigma}\left[\widetilde{q}^2+\alpha\overline{q}\left(\overline{q}-\widetilde{q}\right)-\dfrac{\sigma}{M}\right]+\dfrac{\alpha c}{1-\alpha}N\left(\overline{q}-\widetilde{q}\right). \end{cases} \tag{6.40}$$

Note that when $\alpha \approx 0$, that is when the publisher acquires all revenues from the variable good sales, the distributor's profit simply equals the monopoly profit on the access device market, i.e., N^2/M.

As for the previous section, it is difficult to compare prices in both contract regimes in a general way, as they depend on the bargaining power under wholesale contracts, and the revenue share transferred to the distributor under agency contracts.

6.4 Conclusion

In this paper, we analyze the differences between the wholesale and the agency contractual arrangement for the sale of electronic books. In particular, we have shown that, contrary to what one might expect, in a very simple model, agency mode can lead to higher equilibrium prices than wholesale mode. More specifically, when demand has constant elasticity, the two modes always lead to the same price, and when demand is sufficiently convex and marginal costs not too small, agency pricing leads to higher prices than wholesale.

We then consider the role of access devices (i.e., reading devices such as Kindles and iPads). We have shown that the interplay between usage goods and the access device pricing should be taken into account by antitrust authorities in order to assess the impact of a shift from the wholesale mode to the agency mode on social welfare or consumer surplus. Furthermore, we have explained in detail how heterogeneity in access device valuation plays a role when firms set optimal tariffs in the wholesale mode. In doing so, we generalize the classic formula for two-part tariff, as demonstrated in Schmalensee [1981].

In considering this industry, it is also worth remembering that factors other than access device pricing could also potentially explain the increase in ebook prices when shifting to the agency mode. In particular, U.S. and European antitrust authorities focused on firms' collusive behaviors induced by the agency mode. Finally, a challenging yet important extension would be to introduce competition to our model, building on the literature on two-part tariffs in an oligopolistic setting (see, e.g., Stole [1995], Armstrong and Vickers [2001, 2010]; or Stole [2007] for a review), and on non-linear pricing by duopolists (see Verboven [1999], Rochet and Stole [2002], Yang and Ye [2008], Veiga and Weyl [2012]). Product differentiation and compatibility decisions in the device market could also be interesting to consider.

Part V

The interplay between regulation and competition policy: The case of margin squeeze

In Part V we analyze research questions relative to the use of (ex-post) competition policy in ex-ante regulated markets in the ICT sector. More specifically, we study margin squeeze conducts in the telecommunications industry. The goal of this analysis is to understand whether advantages or weaknesses from ex-ante and ex-post regulation add up when ex-post competition policy is enforced in ex-ante regulated markets.

In Chapter 7 we study margin squeeze as an entry-deterrence strategy in an ex-ante regulated market. We show that a margin squeeze in an ex-ante regulated market only occurs when the access is regulated above cost (this might be so either because of imperfect regulation, or because of the objective function of the ex-ante authority). Standard competition policy rules defining predatory pricing and refusal-to-deal might thus be inappropriate to deter anticompetitive conducts in a market with ex-ante regulation.

In Chapter 8 we analyze the impact of access regulation on a firm's incentive to abuse of its dominant position. More precisely, we show that an increase in the regulated access charge can increase or decrease the incumbent's incentive to undertake a margin squeeze. Indeed, it simultaneously raises the incumbent's upstream profit when it sells input to its competitor, and lowers the cost of abusing of its dominant position. When the discount factor is low enough, the latter effect may dominate, and an increase in the access charge can intensify the incumbent's incentive to undertake a margin squeeze. Hence, ex-ante regulation directly impacts the incumbent's incentive to undertake an anticompetitive strategy.

Overall, in Part V we demonstrate that the interplay between ex-ante and ex-post regulations can be quite difficult to deal with. Indeed, ex-ante regulation may become a concern for ex-post competition policy as it can modify a well-known abuse (as predatory pricing or refusal-to-deal) into a new anticompetitive conducts (margin squeeze) to which case law might be unadapted. Similarly, ex-ante regulation can directly impact a firm's anticompetitive conduct, which can be dealt with ex-post by competition authorities.

Chapter 7

Margin Squeeze and Monopoly Maintenance in Regulated Industries

7.1 Introduction

In March 2012, the General Court of the European Union confirmed the fine of more than €151 million imposed on the Spanish telecommunications incumbent by the European Commission for a margin squeeze in the broadband market. More generally, in recent years, U.S. and European antitrust jurisdictions have dealt with important margin squeeze cases in ex-ante regulated network industries such as telecommunications,[1] energy,[2] and utilities.[3]

On the one hand, U.S. and European antitrust jurisdictions agree on the definition of a margin squeeze. A margin squeeze (or price squeeze) is an anti-competitive conduct set up by a vertically-integrated firm which is dominant in the upstream market. It occurs when the vertically-integrated firm sets its retail

[1]See, e.g., *Commission of the European Communities v. Deutsche Telekom* (Case COMP/C-1/37.451, 37.578, 37.579), and *Commission of the European Communities v. Telefonica* (Case COMP/38.784) in Europe; and *Pacific Bell Telephone Co. v. linkLine Communications, Inc.* (Case 129 S. Ct. 1109) in the U.S.

[2]See, e.g., the French Autorité de la concurrence's decision (2007) in *Direct énergie v Electricité de France (EDF)* (Case 07-D-43).

[3]See, e.g., the British OFWAT's decision (2004) in *Albion Water v Dŵr Cymru* (Case CA98/00/48).

price too low relative to its access charge for downstream competitors to survive.[1]

One the other hand, major transatlantic differences have emerged in the legal treatment of margin squeeze cases. For example, whereas the U.S. Supreme Court stated that the Sherman Act does not recognize margin squeeze as a theory of harm in monopolization cases when there is no antitrust upstream duty-to-deal, the European Court of Justice stated that margin squeeze constitutes a stand-alone infringement.

These differences reflect a vivid debate in the policy literature on whether or not margin squeeze should be dealt with by competition authorities in ex-ante regulated markets, and whether or not margin squeeze should be recognized as a stand-alone conduct. Sidak [2008] states that "[i]t is neither feasible nor advisable to use antitrust law to make a vertically integrated firm responsible for ensuring the profitability of its competitors in the downstream market."[2] By contrast, Heimler [2010] explains that competition authorities should be allowed to intervene in margin squeeze cases because regulatory authorities may have to set above-cost access charges.

Carlton [2008] and Sidak [2008] also claim that a margin squeeze should not to be recognized as an ex-post anticompetitive conduct. They ask antitrust authorities and courts to rely on other types of abuses, such as predation or refusal-to-deal, in order to prove an anticompetitive conduct. In the *linkLine* case, the Supreme Court followed this argument.[3] But, as Heimler [2010] explains, the Supreme Court did not explain whether or not a margin squeeze could be recognized as a stand-alone abuse when there exists an antitrust duty-to-deal.

Hence, margin squeeze is currently quite debated in the policy literature, mainly because theories underlying margin squeeze strategies are missing. In this chapter, we develop a theory for margin squeeze based on vertical defensive leveraging. We show that an incumbent can undertake a margin squeeze in

[1]In the literature and in recent case law, the access charge is sometimes called 'input price,' 'wholesale price,' or 'upstream price.'

[2]This is also the point of view of the Supreme Court, which stated, in the *linkLine* case, that this is the role of an ex-ante regulatory authority to consider precisely the margin between the retail and upstream prices set by an incumbent.

[3]It is to note that, whereas Article 101 of the Treaty on the Functioning of the European Union (formerly Article 82 of the Treaty establishing the European Community) penalizes the abuse of dominance, section 2 of the Sherman Act penalizes illegal acquisition or maintenance of monopoly power (see Sidak [2008]).

equilibrium in order to maintain its upstream monopoly position.

We develop a theoretical model in which margin squeeze might arise in equilibrium as an entry-deterrence strategy. In our two-period model, foreclosure of a more efficient downstream competitor occurs because the vertically-integrated incumbent aims at maintaining its upstream monopoly in the long-run. By deterring entry in the downstream market in the first period, the incumbent reduces the entrant's overall profit and may render second-period entry in the upstream market unprofitable. This strategy corresponds to a vertical variant of the well-known defensive leverage argument (see, e.g., Carlton and Waldman [2002] for an illustration of defensive leveraging through tie-in sales).

Building our discussion on our model and on the case law, we explain why a margin squeeze should be defined as a stand-alone conduct when a competition authority intervenes ex-post in an ex-ante regulated market. More precisely, we explain why a margin squeeze conduct differs from other existing abuses, and why such conduct should be considered as abusive when the access charge is regulated.

The rest of this chapter is as follows. Section 7.2 presents background information regarding the existing literature, and addresses the current legal environments in Europe and in the U.S., by reviewing the recent case law. Section 7.3 introduces the model. In Section 7.4, we show that a margin squeeze can be a dominant strategy for the monopolist, in order to protect its upstream monopoly position. We provide a comprehensive discussion about margin squeeze being defined as a stand-alone abuse in Section 7.5. Finally, Section 7.6 concludes. All proofs are relegated to Appendix 7.7.1.

7.2 Background information

In this Section, we review the relevant literature and we specify the recent case law in Europe and in the U.S.

7.2.1 Literature review

The relevant literature encompasses both literature on vertical foreclosure and the interplay between margin squeeze and regulation.

7.2.1.1 Vertical foreclosure and the leverage theory

As a margin squeeze is a vertical foreclosure strategy, it is concerned with the one-monopoly argument from the Chicago School critique of the leverage concept. This argument states that, as there is only one final monopoly profit to be extracted in vertically-related markets, a vertically-integrated incumbent should always serve a more efficient downstream competitor (see, e.g., Posner [1976], Bork [1978], or Rey and Tirole [2007] for a review).

One explanation to counter the Chicago School argument and to explain the rationality of foreclosure is defensive leverage. This explanation has been developed in the tying literature, for horizontally-related markets. The defensive leverage consists in foreclosing a secondary market in order to protect a monopoly position in the primary market. Indeed, an incumbent may have incentives to foreclose a potential competitor when entry in one market encourages entry in the other market. Several arguments can justify this link between the two markets: Carlton and Waldman [2002] study markets with economies of scale and scope or network effects, and Choi and Stefanadis [2001] give a rationale for the defensive leverage when entry is risky (i.e., when R&D may not succeed).

Even if vertical and horizontal structures differ, this defensive leverage strategy can be extended to vertically-related markets. For instance, as Riordan [2008] explains, when present downstream entry might lead to future upstream entry, a vertically integrated incumbent might refuse to deal in the first period, in order to deter this two-level entry strategy. Similarly, Chen [2013] gives a rational explanation for refusal-to-deal in an unregulated environment.

When access is regulated, however, a refusal-to-deal is not a feasible foreclosure strategy. Indeed, it seems particularly relevant to study margin squeeze abuses in regulated markets. As Vickers [2010] puts it "the presence of regulation is one reason why the Chicago School 'one monopoly profit' argument for scepticism about leverage claims may not apply." In our model, the access charge is set by the regulatory authority and has two effects on the equilibrium. Indeed, it prevents the incumbent to extract a full monopoly rent, and it prevents the incumbent to engage in a refusal-to-deal strategy to protect its upstream monopoly position.

Note that the vertical defensive leverage argument we illustrate in this chapter differs from the Bell doctrine, according to which a regulated monopolist might find it profitable to leverage market power from the regulated to the competitive segment of the market.[1] Indeed, in our model, if there was no regulation at all, the incumbent might still find it profitable to foreclose the market (through a less costly strategy than a margin squeeze, e.g., a refusal-to-deal) to maintain its upstream monopoly position.

The model we develop in this chapter could also be regarded as a vertical variant of the one developed by Fumagalli and Motta [2012]. In their paper, they detail a theory for predatory pricing based on intertemporal price discrimination and economies of scale or scope. In our model the same reasoning appears; having first-period positive output is a key element for overall profitability, as there are common sunk costs in operating first as downstream entrant and then as a vertically-integrated competitor. However, strategic foreclosure can occur at a price above cost in our model.

7.2.1.2 Margin squeeze and regulation

The literature on margin squeeze conducts in regulated industries is scarce. Biglaiser and DeGraba [2001] demonstrate that a margin squeeze can occur in equilibrium when the upstream market is regulated and the entrant faces profit hurdles. However, their model does not illustrate vertical defensive leveraging, because the entrant cannot bypass the upstream input. Furthermore, there are several reasons for which the Chicago school argument breaks down in their model: namely the entrant is less efficient than the incumbent, and firms compete using two-part tariffs.

In a recent paper, Choné, Komly and Meunier [2010] show that, when the regulated access charge is above cost, an ex-post ban on margin squeeze harms consumers for a given market structure, but that it may also increase consumer surplus when it alters this market structure and favors efficient entry. In Choné, Komly and Meunier [2010], however, margin squeeze never occurs in equilibrium and entry is deterred because of the off-equilibrium threat of margin squeeze.

In our paper, we explain why margin squeeze can occur as a foreclosure strat-

[1] See, e.g., Joskow and Noll [1999] for a detailed review of the Bell doctrine. Note also that the Bell doctrine is also called Baxter's law, after William Francis Baxter, the assistant attorney general who settled the AT&T break-up in 1982.

egy in equilibrium, due to economies of scope between the downstream and the upstream market. In this regard, our paper is the first to give a rationale for a margin squeeze strategy which occurs in equilibrium in a model of complete and perfect information.[1]

Biglaiser and DeGraba [2001] also demonstrate that, in their model with horizontal differentiation, the incentive to squeeze always decreases in the access charge. By contrast, Gaudin [2013b], using a model with homogeneous products, shows that raising the regulated access charge may either increase or decrease the incumbent's incentive to squeeze. In particular, the outcome depends on the price-cost margin and the demand elasticity at the squeezing price.

Finally, Bouckaert and Verboven [2004] study how margin squeeze tests are relevant in different regulatory configurations (when upstream and retail prices are regulated, when only upstream prices are regulated, and when there is no regulation). Under exogenously cost-oriented upstream prices, they state that a margin squeeze strategy is similar to predation, as the vertically-integrated firm only sets its retail prices.

7.2.2 Legal environment

We address the current legal environments in Europe and in the U.S. concerning margin squeeze by reviewing the recent case law.

7.2.2.1 Recent case law in Europe

In Europe, two recent margin squeeze cases concerning ex-ante regulated telecommunications incumbents have received a lot of attention. First, in 2003, in *Commission of the European Communities v. Deutsche Telekom*,[2] the European Commission fined the German telecommunications incumbent €12.6 millions for an abusive margin squeeze, which occurred from 1998 to 2001 in the fixed local access sector. This case was much debated, mainly because it drew new frontiers between regulation and competition policy, as Deutsche Telekom's upstream charge was regulated by the German regulatory authority. The European Commission

[1] In Biglaiser and DeGraba [2001] margin squeeze is a feasible strategy because of profit hurdles, which are usually justified by imperfect information in the financial market.

[2] Case COMP/C- 1/37.451, 37.578, 37.579 - Deutsche Telekom AG, case T-271/03 before the European Court of First Instance and case C-280/08 P before the European Court of Justice.

decision was upheld by the European Court of First Instance in 2008, and confirmed by the European Court of Justice, which dismissed in 2010 the appeal brought by Deutsche Telekom.

The different European courts confirmed the European Commission's decision that Deutsche Telekom had to comply with European competition policy laws, even if its pricing strategy had been approved by its National Regulatory Authority. The European Commission stated that, even if its wholesale charge was regulated, the German incumbent had enough flexibility to put an end to the margin squeeze, notably by increasing its retail prices for access services.

In *Commission of the European Communities v. Telefonica*,[1] the European Commission fined Telefonica, the Spanish telecommunications incumbent, €151.875 million for abusing its dominant position in the Spanish broadband market through a margin squeeze from September 2001 to September 2006. The margin squeeze occurred between Telefonica's retail price and its regional and national wholesale access prices. The incumbent's national wholesale price was not regulated and its regional price was subject to an ex-ante price cap, set in 2001 on the basis of the incumbent's forecasts. At the time of the abuse, Telefonica also provided a wholesale access through local loop unbundling at a cost-oriented regulated price. The General Court confirmed the European Commission's fine in March 2012.

7.2.2.2 Recent case law in the U.S.

In the U.S., the Supreme Court's decision in the case *Pacific Bell Telephone Co. v. linkLine Communications, Inc.* clearly widened the gap between transatlantic views on margin squeeze abuses.[2] This case concerned a margin squeeze claim in the Californian broadband DSL market, in which the incumbent had a regulatory upstream duty-to-deal (i.e., it had to set an upstream price lower than its retail price). The Supreme Court rejected the margin squeeze allegation, arguing that if the retail prices are not predatory and if there is no antitrust duty-to-deal, an incumbent is free to set its prices. More precisely, the Supreme Court stated that the "[p]laintiffs price-squeeze claim, looking to the relation between retail and

[1]Case COMP/38.784 *Wanadoo España vs. Telefonica* and cases T-336/07 *Telefonica v. Commission* and T-398/07 *Spain v. Commission* before the General Court.

[2]Supreme Court's decision, Docket No. 07-512. See also the document "OECD Policy Roundtables, Margin Squeeze," 2009 (DAF/COMP(2009)36), to notice the divergences in the contributions of the European Commission and the United States.

wholesale prices, is thus nothing more than an amalgamation of a meritless claim at the retail level and a meritless claim at the wholesale level."

7.3 The model

We set-up a two-period model in order to give a rationale for a margin squeeze strategy.

Firms. There are two firms, an incumbent and a potential entrant. The incumbent I is vertically-integrated and operates in both the upstream and downstream markets. It has an upstream constant marginal cost u_I and a downstream constant marginal cost c_I. The incumbent can sell the upstream input to a downstream competitor, at no extra cost.

The potential entrant E can enter the market as a pure downstream operator or as a vertically-integrated firm. In order to vertically-integrate, the entrant must build both the downstream and upstream facility components. We use the following definitions in the chapter: the entrant *enters* the market when it builds its downstream facilities; and it *invests* when it builds its upstream facilities.

To build its downstream facilities, it has to incur a sunk cost f. The entrant has a downstream constant marginal cost c_E, with $c_E \leq c_I$. That is, we assume that the entrant is more efficient than the incumbent in the downstream market. As a downstream operator, E relies on the incumbent's upstream input and needs one unit of input to produce one unit of output.

Similarly, the entrant has to incur a sunk cost F to build its upstream facilities. When it invests in its own upstream facilities, the entrant has an upstream constant marginal cost u_E. The entrant is more efficient than the incumbent for the provision of the upstream component (i.e., $u_E \leq u_I$), because its technology is more recent. We assume that when it is indifferent between entering (resp., investing) or not, E always chooses to enter (invest).

Finally, we assume that upstream investment is only feasible in the second period. This assumption mirrors the common thinking that, in network industries, short-run entry as a vertically-integrated firm in a market dominated by an incumbent may be too costly. As an example, an entrant could invest in its own upstream facilities only after the first period, because a new technology appears such that the sunk cost to build upstream facilities is infinitely high in the first period, and equals F in the second period.[1] Note that the entrant can become a vertically-integrated competitor in the second period even if it remained outside the market in the first period.

Regulation. We assume that the upstream market is regulated; that is, there is a regulatory authority which sets the price of the incumbent's essential input (the access charge), a. We assume that a is set above the upstream cost, i.e., $a > u_I$. The regulatory authority only sets one access charge for the whole game. Finally, the regulatory authority does not regulate retail prices.

Above-cost regulated access charges are common in the literature. For instance, in Biglaiser and DeGraba [2001] there is an (exogenous) above-cost access charge because of Universal Service Obligations. In Choné, Komly and Meunier [2010], the authors argue that the regulatory authority might not set the access charge at cost, because "[r]egulators may want to encourage competitors to invest in upstream infrastructures, in a long term perspective." Similarly, Heimler [2010] explains that a regulatory authority might set an access charge above cost, for instance because it may favor "the entry of higher-cost competitors that eventually would become more efficient than the incumbent."

Consumers. The firms provide homogeneous products and compete in prices. In each period, demand is characterized by the continuous, decreasing, and positive function $D(p)$, where p is the retail price to which consumers buy the good. Each consumer buys only one unit of the downstream product in each period. We assume that the profit function $(p-c)D(p)$ is continuous and strictly concave in p, for any marginal cost c.

When both firms set the same retail prices, we assume that consumers buy from the firm they know best, i.e., the incumbent.

Following Carlton and Waldman [2002], we assume that the cohort of consumers in the first period differs from the cohort of consumers in the second period, that is, no first-period consumer exists in the second period.[2]

[1] See Bourreau and Doğan [2005] who assume that the entrant cannot build his facility at time zero but that the facility cost decreases over time.

[2] This is also similar to consumers in both periods being myopic, that is, if we assume consumers in a given period are only concerned by this period prices.

Timing. The regulated access charge is exogenously set by the regulator for the whole game before any firms' decision. The timing of the game is then as follows.

1. First period:
   (a) I and E simultaneously set their retail prices for the first period.
   (b) E chooses whether or not to enter the downstream market.
   (c) Consumers purchase the product.
2. Second period:
   (a) I and E simultaneously set their retail prices for the second period.
   (b) E chooses whether or not to invest in upstream facilities if it entered in the first period, or whether or not to enter the market (as a downstream- or a vertically-integrated firm) if it did not.
   (c) Consumers purchase the product.

In this game, we assume that both firms commit to their prices before E's entry and/or investment decision, as in Fumagalli and Motta [2012]. As an example of such commitment, suppose that the firms' and buyers' contracts are made on the basis of tender offers (as in public-private procurement markets) or that buyers are large businesses which can negotiate prices with both firms prior to their purchase decision, and that entry and investment take time because firms have to build some infrastructures to deliver the products or services, such as a telecommunications network.[1]

Note that if the incumbent was unable to commit to its first-period retail price before the potential competitor's entry decision, a margin squeeze would never occur in equilibrium. Indeed, if the incumbent's pricing decision occurs after the

[1] An example of large businesses which can negotiate prices prior to their decisions is given by the 2012 case *Cogent Communications v. France Télécom* in the internet connection peering market, before the French Competition Authority (decision 12-D-18). In this case, Cogent, an international transit operator, whose clients are national Internet Service Providers and Content Providers, claimed that France Télécom entailed a margin squeeze in the internet connection peering market by using its vertically-integrated structure. Indeed, France Télécom is an ISP through its Orange brand, and an international transit operator through its subsidiary Open Transit.

competitor can sunk its fixed cost of entry f, then, either entry is accommodated and there is no incentive for the incumbent to engage in a margin squeeze,[1] or entry is deterred because of the off-equilibrium threat of a margin squeeze, as in Choné, Komly and Meunier [2010].

Finally, we assume that both firms discount their future profits at the same discount rate. Without loss of generality, we assume that the discount factor equals one. We look for the subgame-perfect Nash equilibrium of this game. We solve the game by backward induction.

7.4 Margin squeeze to maintain an upstream monopoly position

We know explain how a margin squeeze can occur in equilibrium.

7.4.1 Second period

At the beginning of the second period, the potential competitor may or may not already have entered the downstream market. We study these two distinct cases below.

E entered the downstream market in the first period. If the competitor entered as a downstream operator, it only decides whether or not to invest in its upstream facilities.

On the one hand, if the entrant's price is higher than the incumbent's, the entrant does not sell any product. Therefore, it will never invest in its upstream facilities. On the other hand, if its (positive) price is lower than the incumbent's, it will earn positive revenues. In this case, the incumbent will be better off undercutting any price above $a + c_I$ and serving the market itself. Therefore, it is not an equilibrium for the entrant to set a price above $a + c_I$ and to remain a downstream operator. We assume that the entrant can never set its monopoly price $p^m(c)$, that is $p^m(a + c_E) > p^m(u_E + c_E) > a + c_I$.

[1]It could nevertheless entail a margin squeeze if the entrant has to face other constraints, such as profit hurdles (see Bolton and Scharfstein [1990], and Biglaiser and DeGraba [2001]).

Suppose that the entrant's price p_E is below the incumbent's one. E can stay a downstream operator and make profit $\pi_E^D(p_E) \equiv (p_E - (a + c_E))D(p_E)$, or it can invest in its upstream facilities at the fixed cost F and become a vertically-integrated firm making (gross of fixed cost) profit $\pi_E^{VI}(p_E) \equiv (p_E - (u_E + c_E))D(p_E)$.

We need to to know at which retail price would the entrant prefer to be a downstream competitor rather than a vertically-integrated firm. We call $\tilde{p_E}$ the price at which the entrant is indifferent between investing or not, knowing that it serves the market, i.e., $\pi_E^D(\tilde{p_E}) = \pi_E^{VI}(\tilde{p_E}) - F$. In the following, we assume that $\tilde{p_E}$ is unique. We can now state the following lemma:

Lemma 7.1. *For any $p < \tilde{p_E}$, we have $\pi_E^D(p) < \pi_E^{VI}(p) - F$, and vice-versa.*

Proof. See Appendix 7.7.1. □

In the following, we assume that $\tilde{p_E} > a + c_I$ (we study the case where $\tilde{p_E} \leq a + c_I$ in Appendix 7.7.2). In this case, whenever it serves the market, that is, when $p_E < p_I$, the entrant will always invest in its own upstream facilities. Indeed, at any price, it would prefer to be a vertically-integrated firm rather than a downstream operator. Anticipating this, the incumbent will undercut any price above $u_I + c_I$, its own marginal cost.

If the entrant is cost-efficient enough then there is Bertrand competition between both firms and E serves all consumers at $p_E = u_I + c_I - \epsilon$, with ϵ being very small. Its net profit is then $\pi_E^{VI}(u_I + c_I) - F$. The incumbent makes no profit at all.

Otherwise, the incumbent serves the market at the entrant's average cost (taking into account the fixed cost F) and the entrant makes no profit.

Comparing the profits made by the entrant in both situations, we can state the following result:

Lemma 7.2. *Suppose the competitor entered the downstream market in the first period. Then, it invests in its own upstream facilities in the second period if and only if $\pi_E^{VI}(u_I + c_I) - F \geq 0$.*

Proof. Omitted. □

We call Condition 7.1 the condition on parameters for which the entrant would invest in its own upstream facilities in the second period if it entered the downstream market in the first period:

Condition 7.1. $F \leq (u_I + c_I - (u_E + c_E))D(u_I + c_I)$.

E **did not enter the downstream market in the first period.** If it did not enter the downstream market in the first period, the entrant can choose in the second period to stay outside the market, to enter the downstream market only, or to enter as a vertically-integrated firm.

As $\tilde{p_E} > a + c_I$, the entrant will always prefer to be a vertically-integrated firm rather than a downstream operator. Therefore, E's choice is reduced to two options: to become a vertically-integrated firm, or to remain outside the market.

First, suppose that $p_E < p_I$. The entrant serves the market and, as it invests as $\tilde{p_E} > a + c_I$, the incumbent makes zero profit. As above, the incumbent will anticipate this strategy and undercut any price above $u_I + c_I$. Therefore, the entrant will make a positive profit if and only if $\pi_E^{VI}(u_I + c_I) - F - f \geq 0$.

Reciprocally, when $p_I \leq p_E$ the incumbent serves the market at price p_I^* such that $\pi_E^{VI}(p_I^*) - F - f = 0$, which the is highest price the entrant cannot undercut. In this case, the entrant does not enter the market because of this limit pricing strategy.

Comparing the profits made by the entrant in both situations, we can state the following lemma:

Lemma 7.3. *Suppose the competitor did not enter in the first period. Then, it remains outside the market in the second period if and only if* $\pi_E^{VI}(u_I + c_I) - F - f < 0$.

Proof. Omitted. □

7.4.2 First period

We study the possible equilibria of the game, according to different values of the downstream entry fixed cost f. We are interested in the case where the entrant has to enter in the first period to become a vertically-integrated competitor in the second period.

If $p_I < p_E$, E stays outside the market in the first period. In this case and if $\pi_E^{VI}(u_I + c_I) - F < f$, we know from Lemma 7.3 that E will never enter the market.

If $p_E < p_I$, E pays the fixed cost f, enters as a downstream operator, and serves the retail market in the first period. In this case and if Condition 7.1 is satisfied, we know from Lemma 7.2 that E will become a vertically-integrated firm in the second period, and that the incumbent will only earn upstream revenues from the first period.

Proposition 7.1. *For a given access charge, if Conditions 7.1 is satisfied, there exist $\underline{f}$ and $\overline{f}$ such that, if $\underline{f} < f \leq \overline{f}$, the unique equilibrium is characterized by: (i) Either E never enters any market, or (ii) E enters the downstream market in the first period and invests in upstream facilities in the second period.*

Proof. See Appendix 7.7.1. □

Proposition 7.1 shows that, for some values of the downstream fixed cost of entry f, being a downstream competitor in the first period is a key strategic element in order to become a vertically-integrated competitor in the second period. When $\underline{f} < f \leq \overline{f}$, if the potential entrant does not compete as a downstream operator in the first period, it will be unable to enter the market (neither downstream, nor upstream) in the second period.

In Proposition 7.1, we introduced $\underline{f}$, the lowest downstream entry cost for which a potential competitor which stayed outside the market in the first period would remain outside the market in the second period: $\underline{f} \equiv \pi_E^{VI}(u_I + c_I) - F$. By contrast, when $f \leq \underline{f}$, E always finds it profitable to enter as a vertically-integrated firm in the second period, regardless of its first-period situation.

We also introduced $\overline{f}$, the highest downstream entry cost for which downstream entry in the market in the first period followed by upstream investment in the second period might be profitable: $\overline{f} \equiv \pi_E^D(a + c_I) + \underline{f}$. By contrast, when $f > \overline{f}$, E never finds it profitable to enter the market.

7.4.3 Margin squeeze as an equilibrium

From Proposition 7.1, the incumbent knows that, when $\underline{f} < f \leq \overline{f}$, the potential competitor has to enter in the first period to become a vertically-integrated operator in the second period. If it does not, it will never enter the market. Therefore, the incumbent might choose to deter entry in the first period, in order to protect its upstream monopoly in the second period.

Proposition 7.2. *For a given access charge, if Condition 7.1 is satisfied and* $\underline{f} < f \leq \overline{f}$*, there exists a unique* $\hat{p_I}$ *such that, if* $(\hat{p_I} - (a + c_I))D(\hat{p_I}) + (p_I^* - (u_I + c_I))D(p_I^*) > 0$*, the unique equilibrium is characterized by the outcome: (i) I serves the first period market by setting a retail price* $\hat{p_I}$ *such that* $\hat{p_I} < a + c_I$*, and (ii) E never enters the market.*

Proof. See Appendix 7.7.1. □

We call Condition 7.2 the condition on parameters for which the incumbent always would find it profitable to deter entry:

Condition 7.2. $(\hat{p_I} - (a + c_I))D(\hat{p_I}) + (p_I^* - (u_I + c_I))D(p_I^*) > 0.$

In Proposition 7.2, we introduce $\hat{p_I}$ as the first-period price at which the incumbent can deter entry. When, in the first period, I sets a retail price below $\hat{p_I}$, then, as $\underline{f} < f \leq \overline{f}$ and following Proposition 7.1, the potential competitor never enters any market. The existence of $\hat{p_I}$ represents the *deterrence ability* of the incumbent; at this price, the incumbent knows that entry would be deterred. In the proof of Proposition 7.2, we demonstrate that $\hat{p_I}$ always exists, is unique, is included in $[a + c_E, a + c_I]$, and that it verifies $(\hat{p_I} - (a + c_E))D(\hat{p_I}) - f + \underline{f} = 0$ by definition.

In his opinion on the *Konkurrensverket v. TeliaSonera Sverige AB* margin squeeze case,[1] advocate general Mazák from the European Court stated that "[t]here is a margin squeeze if the difference between the retail prices charged by a dominant undertaking and the wholesale prices it charges its competitors for comparable products is negative, or insufficient to cover the product-specific costs to the dominant undertaking of providing its own retail products on the downstream market." This corresponds to the standard so-called Equally Efficient Operator definition of margin squeeze, used by European courts and competition authorities.

[1]Case C-52/09, request from the Stockholm District Court to the European Court for preliminary ruling.

Applying this definition to our model would lead to say that the incumbent entails a margin squeeze if it sets a price $p_I < a + c_I$ such that entry is deterred. Note that the price $\hat{p_I}$ might be above or below the incumbent's total cost $u + c_I$. This is the reason why we say this model illustrates a margin squeeze, and not predatory pricing (i.e., below-cost pricing). According to our definition of margin squeeze, predatory pricing is a special case of margin squeeze in vertically-related markets. Note also that, whenever $\hat{p_I} \geq u_I + c_I$, a ban on predation (i.e., below-cost pricing) would not suffice to prevent entry-deterrence.

The margin squeeze we illustrate in our model goes beyond the Bell doctrine, according to which regulation might induce anticompetitive conducts from a vertically-integrated firm. According to Joskow and Noll [1999], in the AT&T divestiture the Bell doctrine made it clear that "regulation was an essential component of creating the incentive and opportunity for sustained, successful anticompetitive behavior and market distortions." By contrast, in our model, imperfect regulation is not always an essential component of creating the incentive for this anticompetitive behavior. Indeed, this behavior may be induced by the defensive leverage strategy only, and might also take place in an unregulated environment as a refusal-to-deal (see Chen [2013]), or in a perfectly regulated environment (when $a = u_I$) as below-cost predation.[1] However, imperfect regulation is an essential component for this anticompetitive behavior to take the form of a margin squeeze, and not one of the above-mentioned conducts.

Proposition 7.2 gives a rational explanation for margin squeeze when the access charge is regulated. It builds on vertical defensive leveraging, according to which an incumbent can foreclose a more efficient downstream entrant in order to prevent this entrant to invest in its own upstream facilities, and hence, in order to maintain an upstream monopoly position. Our model builds on a framework where there are bypass opportunities and access regulation, as in Avenali, Matteucci and Reverberi [2010] and Bourreau and Doğan [2005].[2]

Finally, note that a regulatory authority having power over the access charge might be able to prevent the incumbent to entail a margin squeeze if it could set

[1]Baxter [1983] explains that one of the necessary conditions for the Bell doctrine to hold is that the regulatory authority "must have ineffective control over transactions between the affiliated entreprises," which excludes that the access charge is set at cost.

[2]For a model illustrating the vertical dynamic leverage argument without access regulation, see Chen [2013].

different access charge values for different periods of time. Indeed, the regulatory authority might set access charges such that the entrant has enough incentives to enter in the first period and to invest in the second one, and that the incumbent finds it profitable to earn upstream revenues in the first period. Additionally, if the incumbent prefers to deter entry in order to maintain its upstream monopoly even when the first-period access charge is low (or a cost), margin squeeze occurs at a predatory (below cost) price, and, hence, can be avoided if predatory bans are applicable.

However, an entrant may be simultaneously close to investing in its upstream network in high-density areas and far from investing in low-density areas, because of differences in network fixed costs between areas. In other words, the first period does not last the same in high- or low-density areas. Therefore, a period-by-period access charge regulation is hard to monitor accurately for the regulatory authority, as regulatory rules are generally stated at a country/region level. Similarly, the regulatory authority might be unable to set a time-dependent access charge if there are several entrants, which have entered the market in different periods of time (see Avenali, Matteucci and Reverberi [2010]).

7.5 Discussion: Margin squeeze as an ex-post stand-alone abuse

We showed that it can be a dominant strategy for a regulated incumbent to exert a margin squeeze in order to foreclose a downstream rival, and, hence, to protect its upstream monopoly position. In this section, we explain why this margin squeeze strategy constitutes a stand-alone abuse when analyzed ex-post. First, we explain why the type of margin squeeze we illustrated in our model differs from well-defined abuses such as below-cost pricing, price discrimination, tying, and refusal-to-deal. Second, we explain why this type of margin squeeze should be considered as an abuse of dominance.

7.5.1 Margin squeeze under regulation: A specific form of predation?

There exist several definitions to predatory pricing. If we follow an economics-based definition of predation, a margin squeeze can be defined as a predatory conduct.

Economics-based approach to predation. An economics-driven definition of predation is given by Bolton, Brodley and Riordan [2000]. They define predation as "a price reduction that is profitable only because of the added market power the predator gains from eliminating, disciplining or otherwise inhibiting the competitive conduct of a rival or potential rival. Stated more precisely, a predatory price is a price that is profit maximizing only because of its exclusionary or other anticompetitive effects."[1]

Similarly, de la Mano and Durand [2010] call for a three-step structured rule of reason to assess predation. They state that predation must verify (i) evidence of profit sacrifice, (ii) evidence of likely exclusion, and (iii) evidence of likely recoupment, in order to be distinguished from fair price competition.

The margin squeeze we illustrate in our model correspond to these definitions, as the incumbent incurs a loss or forgoes upstream profits in the first period in order to foreclose a more efficient potential competitor, with a view to maintaining its upstream monopoly position. We also observe a recoupment in the second period as the incumbent sets a high non-competitive price after entry is deterred.

[1] According to this definition, predation may be used to induce a rival's exit and/or to deter entry. We adopt this definition as we focus on the case defined by our theoretical analysis, in which a margin squeeze can be set by the incumbent for entry deterrence purposes only. This dual-property of predation (exit and/or entry deterrence) has also been used by some other authors to define predation. For instance, Joskow and Klevorick [1979] stated that "[p]redatory pricing behavior involves a reduction of prices in the short run so as to drive competing firms out of the market or to discourage entry of new firms in an effort to gain larger profits via higher prices in the long run than would have been earned if the price reduction had not occurred." It is also the one used by the European Commission, as stated in its 2009 Guidance document, in which the Commission refers to "actual or potential competitors." It is to note, however, that some other authors only define predation as a mean to exclude actual competitors (as an example, in the OECD Glossary of Statistical Terms, predatory pricing is defined as a strategy of "driving competitors out of the market," with a reference to entry deterrence only after the exclusion of actual competitors, so as to avoid re-entry).

Form-based approach to predation. A form-based approach to predation, as applied by courts, generally requires below-cost pricing (the Areeda-Turner test). That is, the predatory price has to be below a certain measure of costs. In our model, the margin squeeze might occur at $\hat{p_I} < u_I + c_I$, but also at $\hat{p_I} \geq u_I + c_I$, and, hence, can be defined as below-cost or above-cost predatory pricing.[1]

Or, above-cost predatory pricing is generally not recognized as an anticompetitive conduct. Indeed, as Elhauge [2003] and Carlton [2008] argue, restrictions on above-cost pricing conducts might wrongfully restrict price competition and protect less efficient competitors, and, therefore, might reduce social welfare.

More precisely, Carlton [2008] states that U.S. courts treat above-cost predatory pricing as lawful because a rule that would penalize above-cost prices would be (i) difficult to administer, (ii) unpredictable in application, and (iii) would discourage pro-consumer price cutting. Similarly, Elhauge [2003] argues that there are inherent implementation difficulties associated to an above-cost predation ban, and that such a rule is not administrable. In addition, he states that only less efficient entrants would be penalized by an above-cost predatory price.

However, some of these arguments do not hold when we consider the vertical structure in which a margin squeeze takes place. A margin squeeze might be easily detected through a so-called "imputation test," which compares the incumbent's retail price, the access charge set by the regulatory authority, and the downstream average variable cost of the incumbent. This test hence defines a margin squeeze as a pricing conduct such as $p_I < a + c_I$.[2] This test is comparable to a price-cost comparison for below-cost pricing regarding implementation difficulties and ex-ante predictability.

Therefore, even if it fits the above-cost predation definition, a margin squeeze does not verify the main economic argument for which above-cost predation is considered as lawful by courts or authorities.

Hence, a margin squeeze under a regulated access charge may or may not correspond to predation, regarding which definition we use for predation. On

[1] See, e.g., Edlin [2002] for an essay on the anticompetitive effects of above-cost predatory pricing.

[2] Note that, whereas European authorities and courts rely on this imputation test to detect a margin squeeze, the U.S. Supreme Court does not recognize such a test. As it states in its *linkLine* decision: "[w]hether or not that test is administrable, it lacks any grounding in our antitrust jurisprudence."

the one hand, when a broad economics-based definition is given for predation, all the deterrence strategies in our model may be considered as predatory conducts. On the other hand, when a form-based approach to predation is employed, such strategies may correspond either to below-cost or above-cost predatory pricing. When above-cost prices are not considered as predatory by courts, all the anti-competitive effects arising from a margin squeeze cannot be managed under the existing rules that condemn predatory pricing, and a margin squeeze would have to be categorized as an independent anticompetitive conduct.

7.5.2 Margin squeeze differs from other anticompetitive conducts

We now explain why the margin squeeze conduct we outline in our model differs from refusals-to-deal, tying, and price-discrimination.

Refusal-to-deal. In our model, there is ex-ante regulation at the upstream level as the access charge is set by the regulatory authority. Therefore, in this regard, the incumbent has a duty-to-deal with the competitor and there cannot be any refusal-to-deal.[1] Indeed, as Vickers [2010] puts it, "regulation gives more, not less, reason to apply competition law to refusal to supply cases," because "in regulated industries, unlike elsewhere, there is typically a duty to deal in the first place."

Tying. A tying strategy and the margin squeeze we illustrate in our model of vertically-related markets are different conducts. One reason is that, whereas under tying all goods are sold directly to final consumers, in a margin squeeze the input is sold to a downstream competitor. The vertical structure of our model

[1] Whereas in EU competition authorities generally view a regulatory duty-to-deal as creating a baseline for the application of competition laws, in the U.S. a court may distinguish an antitrust duty-to-deal from a regulatory duty-to-deal. This is what happened in the *linkLine* case; the incumbent was subject to a regulatory duty-to-deal which the Supreme Court did not recognize as binding under antitrust laws (the access charge was not regulated, but the incumbent had to set a retail price higher than or equal to its upstream charge). Instead, the Supreme Court stated there was no existing antitrust duty-to-deal, and, hence, that the case could not be brought under Section 2 of the Sherman Act, as long as the incumbent's prices were not predatory.

is therefore a key element for the incumbent to abuse its upstream dominant position.

Another difference between tying and a margin squeeze conduct is that, in our model, the access charge is regulated.[1] Therefore, the incumbent only has one instrument to set up this anticompetitive conduct; its retail price.

Price-discrimination. In our model, we suppose that vertical integration does not permit the setting of an internal price for the input. Therefore, the squeeze in our model cannot be analyzed according to a price-discrimination conduct.

However, if the setting of an internal price was feasible, the incumbent would be able to abuse its upstream dominant position by setting discriminatory prices between its own downstream retailer and its competitor. If the anticompetitive conduct is proven and the incumbent stated that it charged the same price for both downstream firms, this would mean that the incumbent's downstream division engaged in a below-cost predatory pricing conduct.

We have explained why the margin squeeze such in our model is a stand-alone conduct, as it differs from well-established conducts as below-cost predation, refusal-to-deal, tying, or price discrimination. It is to note that the European Commission, followed by European courts, have given margin squeeze a stand-alone definition. That is, in EU law, there is no need to demonstrate that access charges or retail tariffs are abusive on their own for a margin squeeze to be recognized as abusive. By contrast, in the U.S., the Supreme Court stated so far that a margin squeeze is not a stand-alone anticompetitive abuse under section 2 of the Sherman Act, and that margin squeeze cases might only be condemned under antitrust laws if anticompetitive predation or refusal-to-deal is proven.[2]

7.5.3 Margin squeeze as an anticompetitive abuse

We demonstrated that a margin squeeze under access regulation is a stand-alone conduct. We now show that this conduct should be defined as abusive.

[1]See, e.g., the paper by Carlton and Waldman [2002] in which the incumbent is unconstrained in setting its primary product price.

[2]It is to note, however, that the Supreme Court has not defined yet margin squeeze in the presence of an antitrust duty-to-deal.

Firstly, Carlton [2008] claims that a margin squeeze ban would cause consumer harm, because such a ban would induce downstream competitors to raise their retail prices as they would be protected by an 'umbrella' from tough price competition; and, hence, that a margin squeeze should not be considered as a stand-alone anticompetitive conduct. Similarly, Sidak [2008] concludes that such a ban "would create a powerful incentive for the vertically integrated firm to raise its retail price to reduce the risk of antitrust lawsuits by unprofitable downstream competitors."

As Choné, Komly and Meunier [2010] demonstrate using a theoretical model, if the (more efficient) downstream competitor would also enter or stay in the market under a lower retail price set by the incumbent, a margin squeeze ban would allow the competitor to raise its price, as compared to the no-ban case. However, Choné, Komly and Meunier [2010] also explain why such a ban would bring efficiency, when the downstream competitor would be foreclosed if the incumbent was entailing a margin squeeze. In this regard, declaring a margin squeeze as abusive would be welfare-enhancing.

The welfare impact of the umbrella effect is related to the shape of the demand curve, and to the surplus split between the two firms. Firstly, when the demand curve is steep on the interval $[a + c_E, a + c_I]$, the impact of the umbrella effect on social surplus is low, as demand is almost the same for any price in this interval. Secondly, if the entrant is able to extract all extra-surplus introduced by its lower downstream cost, there is no umbrella effect.

Secondly, another argument from the opponents of the recognition of margin squeeze as an abuse of dominant position is that a margin squeeze ban harms vertical integration incentives and favors double-marginalization. We argue that our analysis opposes three counter-arguments to this claim. First, in our model the incumbent already is vertically-integrated at the beginning of the game, as it is a former monopolist. Hence, there is no further integration incentives to be gained. Second, when the access charge is regulated, the incumbent might not be able to use fully its upstream monopoly power. Hence, the upstream margin might not always be important. Third, in our model the incumbent engages in a margin squeeze strategy in order to prevent the alternative competitor to invest in its own upstream facilities. Or, if the competitor manages to do so, it would become a (more efficient) vertically-integrated firm and this would put an end to double marginalization.

In this discussion, we exposed why the margin squeeze we illustrate in our model should be defined as a stand-alone conduct, and why a margin squeeze, when the access charge is regulated, may harm competition and should be considered as an anticompetitive abuse. We did not answer the question, however, on whether a margin squeeze should in general be dealt with by regulatory or competition authorities. Nevertheless, when the downstream market is outside the intervention scope of the regulatory authority, only competition agencies are always able to deal, ex-post, with margin squeeze abuses.

7.6 Conclusion

In this chapter, we developed a theory for a margin squeeze strategy based on vertical defensive leveraging. We set-up a two-period model of competition between an incumbent and a potential entrant in order to show that margin squeeze can occur as an entry-deterrence strategy in equilibrium, when the access charge is regulated.

The vertically-integrated incumbent might engage in a margin squeeze to deter entry, in order to maintain its upstream monopoly position in the second period. The logic of foreclosure hence follows the vertical defensive leverage argument, according to which the incumbent monopolizes the downstream market because it will lose its upstream monopoly position if it does not.

In this chapter, we only focused on the case of an incumbent entailing a margin squeeze when the price of the upstream essential input is regulated. Our analysis could thus be extended with discussions on margin squeeze conducts in other regulatory configurations (for instance, under no regulation, or price-cap regulation at the upstream level).

7.7 Appendix

7.7.1 Proofs

Proof of Lemma 7.1. We know that $\pi_E^D(p) \leq \pi_E^{VI}(p)$, $\forall p$, because when it is a vertically-integrated firm, the entrant benefits from lower marginal costs.

When we take into account the fixed cost F, the profit curve $\pi_E^{VI}(p)$ is translated downward. We assumed that $\tilde{p_E}$ is unique, that is, the profit curves $\pi_E^D(p)$ and $\pi_E^{VI}(p) - F$, which are strictly concave, cross only once, at price $\tilde{p_E}$. Below this point, the profit curve $\pi_E^{VI}(p) - F$ will be above $\pi_E^D(p)$, and *vice-versa*. □

Proof of Proposition 7.1. We assume that Condition 7.1 is satisfied. By comparing the two options the E has in the first period, we can see that it will set a price lower than the incumbent's one in the first period (and then invest in its own upstream facilities in the second period) if and only if it makes total positive profits. Indeed, it will make zero profit if it does not enter in the first period and if $\pi_E^{VI}(u_I + c_I) - F \equiv \underline{f} < f$, as we know from Lemma 7.3 that E will never enter the market.

Furthermore, I will never set a price below $a + c_I$. Indeed, even if it seeks to maximize its first-period profit only, the incumbent will undercut any price below $a + c_I$, as it would be more profitable for it to serve the market at such a price rather than to earn upstream revenues.

Therefore, E will never enter the market when it cannot make overall positive profit with a price $a + c_I$ in the first period. At such a price, its total profit equals $(c_I - c_E)D(a + c_I) - f + \underline{f}$. We define $\overline{f} \equiv (c_I - c_E)D(a + c_I) + \underline{f}$ as the highest downstream entry cost for which E can profitably enter the market when Condition 7.1 is satisfied. □

Proof of Proposition 7.2. We demonstrate the proof in two steps. First, we define $\hat{p_I}$ as the incumbent first-period price at which the entrant is indifferent between entering or not the market, when $\underline{f} < f \leq \overline{f}$. Second, we define when it is profitable for the incumbent to deter entry.

When $\underline{f} < f \leq \overline{f}$, the incumbent can set a first-period price that is so low that the potential competitor would prefer not to enter, in any period. We define $\hat{p_I}$ as the incumbent first-period price at which the entrant is indifferent between entering the downstream market (and then invest, from Proposition 7.1) and not entering the downstream market (and then stay outside the market, from Proposition 7.1), in the first period. We write $\hat{p_I}$ such that: $(\hat{p_I} - (a + c_E))D(\hat{p_I}) - f + \underline{f} = 0$.

If we write $g(p) \equiv (p - (a + c_E))D(p) - f + \underline{f}$, we can state that $g(a + c_I) > 0$, as $f \leq \overline{f}$; and that $g(a + c_E) < 0$, as $\underline{f} < f$, and f is positive. Or, $g(p)$ is a sum of continuous functions and, hence, is continuous. Therefore, there exists at least one $\dot{p} \in [a + c_E, a + c_I]$ such that $g(\dot{p}) = 0$.

Furthermore, as $(p - c)D(p)$ is strictly concave in p, then $g(.)$ is also strictly concave. Therefore, there exists only one $\dot{p} \in [a + c_E, a + c_I]$ such that $g(\dot{p}) = 0$. We call this price $\hat{p_I}$.

To foreclose the entrant, the incumbent would set a price $\hat{p_I}$ and would serve all consumers. Indeed, if the incumbent sets a price above $\hat{p_I}$, the entrant would enter the market in the first period (and then invest in the second period, from Proposition 7.1). Additionally, if the incumbent sets a price below $\hat{p_I}$, the incumbent's total profit increases in its retail price.

Finally, when $\underline{f} < f \leq \overline{f}$, the incumbent always obtains greater profits by squeezing the entrant if $(\hat{p_I} - (u_I + c_I))D(\hat{p_I}) + (p_I^* - (u_I + c_I))D(p_I^*) > (a - u_I)D(\hat{p_I})$. $\square$

7.7.2 Margin squeeze when $\tilde{p_E} \leq a + c_I$

In this appendix we explain why a margin squeeze may also arise in equilibrium when $\tilde{p_E} \leq a + c_I$.

7.7.2.1 Second period

When $\tilde{p_E} \leq a + c_I$, in the second period the entrant may be a downstream operator.

E **entered the downstream market in the first period.** In this case, in contrast to what we found above, the unique equilibrium with E investing in upstream facilities is not the only equilibrium with E serving the market in the second period. Indeed, E may remain a downstream operator in the second period. More precisely, there exists a continuum of equilibria in which E serves the downstream market at price p_E and I earns upstream revenues in the first period, with $a + c_E \leq p_E \leq a + c_I$.

Indeed, both firms would undercut a price larger than $a + c_I$, whereas none of them would like to serve the market at a price below $a + c_E$ (the incumbent prefers that its competitor serves the market at a price below $a + c_E$ and the latter would make a negative profit doing so). Besides, the incumbent will never undercut the entrant when the latter sets a price in the interval $[a + c_E, a + c_I]$. Indeed, for any retail price below $a+c_I$, the incumbent earns a higher profit when operating in the upstream market only than when serving the downstream market itself. However, the incumbent would like the entrant to set the lowest feasible retail price in order to increase demand and its upstream profit. By contrast, the entrant earns a larger profit serving the market at a high retail price. Hence, the entrant serving the retail market at a price p_E with the incumbent earning upstream revenues and setting a retail price slightly above the entrant's one is an equilibrium for any $p_E \in [a + c_E, a + c_I]$. The multiple equilibria correspond to the different splits of the surplus from the entrant's cost advantage between both firms. Note that the existence of a continuum of equilibria is a standard result in the literature (see Choné, Komly and Meunier [2010]; or Choi and Stefanadis [2001] and Carlton and Waldman [2002] for a similar result in horizontally-related markets).

In addition, the incumbent would like to undercut any price below $\tilde{p_E}$, because it will not make any profit at this price, as the entrant will invest. Furthermore, I cannot credibly commit to a price below $u_I + c_I$ in the second period; and, finally, E will not set any price below $a + c_E$ if it does not invest, because this would give it a negative profit. Hence, for all prices in the interval $[\max\{a + c_E, u_I + c_I, \tilde{p_E}\}, a + c_I]$, there is a continuum of equilibria with E serving the downstream market and I earning upstream revenues.

Lemma 7.4. *Suppose the competitor entered the downstream market in the first period. There is a continuum of equilibria where it serves the market as a downstream operator at price* $p_E \in [\max\{a + c_E, u_I + c_I, \tilde{p_E}\}, a + c_I]$.

Proof. Omitted. □

Nevertheless, there might be an equilibrium in which E invests in its upstream facilities, as stated in the following lemma:

Lemma 7.5. *Suppose the competitor entered the downstream market in the first period. Then, there is a unique equilibrium in which it invests in its own upstream facilities in the second period if and only if the following two conditions are satisfied:*

(i) $\tilde{p_E} > u_I + c_I$ *or* $a + c_E > u_I + c_I > \tilde{p_E}$*;*

(ii) $\pi_E^{VI}(u_I + c_I) - F \geq 0$.

Otherwise, there is no such equilibrium.

Proof. We know that $\tilde{p_E} \leq a + c_I$. First, suppose that $\tilde{p_E} \geq u_I + c_I$. The incumbent would undercut any price between $\tilde{p_E}$ and $u_I + c_I$. Hence, the equilibrium in which E invests occurs at price $u_I + c_I$. It is a subgame perfect Nash equilibrium if it is profitable for the entrant to serve the market at this price.

Second, suppose that $\tilde{p_E} < u_I + c_I$. When $u_I + c_I > a + c_E$, the entrant will never invest in its own facilities, as the incumbent cannot undercut any price below $u_I + c_I$, and the entrant finds it more profitable to stay a downstream operator at this price. By contrast, when $a + c_E > u_I + c_I$, there is such an equilibrium. □

Note that both the entrant and the incumbent would benefit from any of the equilibria where the entrant is a downstream operator as compared to the one where the entrant invests in its facilities. However, the latest equilibrium might occur because of mis-coordination between both firms.

E did not enter the downstream market in the first period. As above, if E did not enter the downstream market in the first period, then it can set a higher price than the incumbent to remain outside the market and make zero profit, or it can undercut the incumbent and invest in upstream facilities at price $u_I + c_I$ and make profit $\pi_E^{VI}(u_I + c_I) - F - f$.

However, there is also another option: E can enter the downstream market at price $p_E < p_I$, and make profit $\pi_E^D(p_E) - f$. We define $\ddot{p}$ as the price at which the entrant makes zero profit if it serves the market as a downstream firm, i.e., $\pi_E^D(\ddot{p}) - f = 0$.

Lemma 7.6. *Suppose the competitor did not enter in the first period. Then, it remains outside the market in the second period if and only if the following two conditions are satisfied:*

(i) $\pi_E^{VI}(u_I + c_I) - F - f < 0$;

(ii) $\ddot{p} < \max\{a + c_E, u_I + c_I, \tilde{p_E}\}$.

Proof. Condition (i) ensures that the entrant will prefer to remain outside the market than to become a vertically-integrated firm. Condition (ii) ensures that the entrant will prefer to remain outside the market than to become a downstream operator. Indeed, as the profit function is concave, whenever $\ddot{p} < \max\{a+c_E, u_I+c_I, \tilde{p_E}\}$ (where $\max\{a+c_E, u_I+c_I, \tilde{p_E}\}$ is the lowest equilibrium price at which the entrant can be a downstream operator) the entrant does not earn a positive profit by entering the downstream market. □

7.7.2.2 First period

We see from Lemma 7.6 that for some parameters, as in Proposition 7.1, being a downstream operator in the first period is a key element for the entrant to remain in the market and to invest in the second period. Therefore, the incumbent might entail a margin squeeze in order to deter entry, as in Proposition 7.2. Indeed, the incumbent may fear that the selected equilibrium in the second period is the one with the entrant investing when the latter enters in the first period, and, hence, behave predatorily by entailing a margin squeeze.

Similarly, the incumbent might entail a margin squeeze if it is profitable for it to become a monopolist, even though the entrant would not invest in the second period. Indeed, following the Bell doctrine, the monopolist might prefer to foreclose the market because it cannot extract a full monopoly rent because of regulation.

This proves that margin squeeze can also occur in equilibrium when $\tilde{p_E} \leq a + c_I$.

Chapter 8

The Interplay between Margin Squeeze and Regulation

8.1 Introduction

Among economists and legal scholars, whether or not ex-post antitrust laws should apply to ex-ante regulated markets is a long-standing debate. Therefore, having a clear understanding of how ex-ante regulation influences anticompetitive conducts is of prime importance. In this regard, it is interesting to note that, in recent years, U.S. and European competition authorities and courts have dealt with important predatory cases in ex-ante regulated industries, such as telecommunications,[1] energy,[2] and utilities.[3]

These industries are generally characterized by a vertically-integrated firm, owner of an upstream essential facility, whose access charge is subject to ex-ante regulation. In this case, a vertically-integrated firm which sets low retail prices can foreclose the market by squeezing its competitor's margin. Therefore, we can consider margin squeeze (or price squeeze) as a predatory conduct.[4] The

[1]See, e.g., *Commission of the European Communities v. Deutsche Telekom* (Case COMP/C-1/37.451, 37.578, 37.579), and *Commission of the European Communities v. Telefonica* (Case COMP/38.784) in Europe; and *Pacific Bell Telephone Co. v. linkLine Communications, Inc.* (Case 129 S. Ct. 1109) in the U.S.

[2]See, e.g., the French Autorité de la concurrence's decision (2007) in *Direct énergie v Electricité de France (EDF)* (Case 07-D-43).

[3]See, e.g., the British OFWAT's decision (2004) in *Albion Water v Dŵr Cymru* (Case CA98/00/48).

[4]This pricing strategy differs from a raising rival's cost strategy (or 'non-price predation,'

purpose of this chapter is precisely to understand the impact of the regulated access charge on the vertically-integrated firm's incentive to behave predatorily and to foreclose the market.[1]

The regulated access charge influences the vertically-integrated incumbent's incentive to undertake a margin squeeze according to two opposite effects. On the one hand, an increase in the access charge raises the incumbent's upstream revenues when it serves its downstream competitor, making margin squeeze less likely. On the other hand, the incumbent's 'squeezing price' – the retail price at which competition is eliminated – increases in the access charge, because the latter is part of the competitor's marginal cost. In turn, this lowers the incumbent's cost to behave predatorily.

The tradeoff between these two effects has received little attention in the literature. One notable exception is the contribution by Biglaiser and DeGraba [2001]. The authors study a horizontally-differentiated market *à la* Hotelling and find out that the incentive to engage in a margin squeeze always decreases in the access charge, as the 'upstream-profit effect' overcomes the 'cost-reduction effect.' This clear-cut result has been echoed by economists as well as policymakers (see Vogelsang [2003], and the U.S. contribution in OECD [2009]).[2]

In this chapter, we show that the incentive to undertake a margin squeeze might either decrease or increase in the access charge, in contrast to the result in Biglaiser and DeGraba [2001]. We explain precisely the two effects at stake when the access charge increases. We demonstrate that, as the cost-reduction effect occurs in the first period only whereas the upstream-profit effect takes place in both periods, a low-enough discount factor may induce the cost-reduction effect to overcome the upstream-profit effect, thus leading the incentive to undertake a margin squeeze to increase in the access charge.

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see Salop and Scheffman [1983, 1987]), as the incumbent's own cost is not directly affected whether or not the cost of the downstream operator increases (i.e., when the access charge increases).

[1]Such a conduct might occur below-cost (predation), or above-cost (margin squeeze), as the access charge might be regulated above the upstream cost. For consistency reasons, we refer in general to 'margin squeeze strategies,' acknowledging that the squeezing price might be below or above cost.

[2]Vogelsang [2003] states, at p. 839, that "[w]hile higher access charges increase opportunities for predation, they reduce the incentive to do so;" and in OECD [2009], p. 249, one can read that "higher wholesale prices actually discourage using a margin squeeze to drive downstream rivals out of the market."

This chapter relates to the literature on anticompetitive pricing conducts undertaken by a vertically-integrated firm facing downstream competitors which rely on its bottleneck input.[1] The Chicago School claimed that a monopolist owner of an essential facility would have no incentive to foreclose a more efficient downstream competitor (Posner [1976], Bork [1978]). However, there are some circumstances where the Chicago School argument does not hold (see, e.g., Rey and Tirole [2007] for a review). For instance, Chen [2013] shows that a vertically-integrated incumbent may refuse to deal with a more efficient downstream competitor in order to protect its upstream monopoly position. Indeed, the competitor's entry in the downstream market might facilitate its investment in the upstream market in the long run, because of economies of scope between the downstream and upstream products for instance.

Similarly, as Vickers [2010] puts it, "the presence of regulation is one reason why the Chicago School 'one monopoly profit' argument for scepticism about leverage claims may not apply." This is known as the Bell doctrine: a regulated monopolist might find it profitable to leverage market power from the regulated to the competitive segment of the market.[2]

this chapter differs from the existing literature as we do not restate why regulation can induce anticompetitive conducts that would not take place without regulation. Instead, we consider access regulation as given, and we analyze the impact of the level of the regulated access charge on the incumbent's incentive to undertake a margin squeeze.

Apart from Biglaiser and DeGraba [2001], only few authors have studied margin squeeze strategies in a regulated environment. Bouckaert and Verboven [2004] study the application of margin squeeze tests under different regulatory regimes. They argue that margin squeeze tests should be used as an ex-post instrument only when access charges are regulated and retail prices are left unregulated, which is the framework we use in this chapter.

Choné, Komly and Meunier [2010] analyze the welfare impact of an ex-post margin squeeze ban under potential entry and ex-ante access regulation, taking

[1] In this chapter, we do not consider non-price discrimination (or sabotage) strategies. For a review of this literature, see, e.g., Economides [1998], Mandy [2000], Weisman and Kang [2001], and Mandy and Sappington [2007].

[2] The Bell doctrine is also called Baxter's law, after William Francis Baxter, the assistant attorney general who settled the AT&T break-up in 1982.

into consideration the 'umbrella effect." This effect corresponds to the incumbent's incentive to raise retail prices when margin squeeze is banned ex-post (see also Carlton [2008]). They show that an ex-post margin squeeze ban can be welfare increasing when it induces entry of the downstream competitor which would have been otherwise foreclosed. However, they explain that such a ban may reduce welfare because of the umbrella effect if the competitor would have entered the market anyway.

We contribute to the literature by analyzing the interplay between engaging in a margin squeeze and regulation of the access charge. We explain why a regulatory authority should carefully monitor possible anticompetitive conducts when raising the regulated price of the upstream input, as it may increase the incumbent's incentive to undertake a margin squeeze doing so.

The rest of this chapter is as follows. The model is introduced in Section 8.2. In Section 8.3, we solve the model, and we present our main results on the incumbent's incentive to undertake a margin squeeze in Section 8.4. Some robustness checks and extensions are provided in Section 8.5, and Section 8.6 concludes.

8.2 The model

Firms. There are two firms, a vertically-integrated incumbent I and a downstream entrant E. The incumbent has a constant upstream marginal cost c_u and a constant downstream marginal cost c_I. It can sell the upstream input to a downstream competitor, at no extra cost.

As a downstream operator, E relies on the incumbent's upstream input and needs one unit of input to produce one unit of output. The entrant has a downstream constant marginal cost c_E, with $c_E \leq c_I$. That is, we assume that the entrant is more efficient than the incumbent in the downstream market.[1] The firms provide homogeneous products and compete in linear prices. Finally, we denote the incumbent's discount factor by δ, with $\delta \geq 0$.

[1]In the opposite case, the competitor's entry would not be welfare-enhancing, and, hence, the need for regulation may not be justified.

Consumers. In each period, demand is characterized by the continuous, decreasing, and non-negative function $D(p)$, where p is the retail price at which consumers buy the good. Each consumer buys only one unit of the downstream product in each period. We assume that the profit function $\pi(p; c) \equiv (p-c)D(p)$ is continuous and strictly concave in p. For a given cost c, profit is hence maximized at the monopoly price $p^m(c)$. We define $\pi_I^m \equiv (p^m(c_I+c_u)-(c_I+c_u))D(p^m(c_I+c_u))$ as the incumbent's profit when it is a monopolist at the retail level. We denote by Π the incumbent discounted profits.

When both firms set the same retail price, we assume, without lost of generality, that the incumbent serves the retail market. This is because consumers feel more comfortable to buy from the firm they already know, when prices are equal.

We assume that the cohort of consumers in the first period differs from the cohort of consumers in the second period; that is, no first-period consumer exists in the second period. Similarly, we could consider myopic consumers who would only be concerned by the prices in the current period.

Regulation. The regulatory authority sets the incumbent's access charge, a, but does not regulate retail prices. The regulatory authority sets the access charge above the incumbent upstream marginal cost to cover the per-period fixed costs associated with broadband provision. Therefore, we assume that the regulated access charge is defined on a bounded interval and is higher than the upstream marginal cost; that is, $a \in [\underline{a}, \overline{a}]$, with $\underline{a} \geq c_u$.[1]

Besides, as we focus on situations where the incumbent is constrained by regulation, we study the cases where $\overline{a} \leq a^m$, where $a^m \equiv p^m(c_I + c_u) - c_I$ is the access charge that corresponds to the efficient component pricing rule (ECPR), or retail-minus.

As a technical assumption, we consider that the entrant does not have a strong

[1]As explained by Laffont and Tirole [2001], a regulatory authority generally sets a at an intermediate level, as a high access charge sets high barriers to entry and might lead to inefficient duplication of the bottleneck, whereas a low access charge discourages incumbents from investing, dissuades entrants from building their facilities, and might lead to inefficient entry. Similarly, Heimler [2010] explains why a regulatory authority sets an above-cost access charge to help entrants to build their own facilities, hence giving scope to the incumbent to undertake a margin squeeze. In addition, a regulatory authority may set an above-cost access charge for funding universal service obligations, or because of information asymmetries.

downstream-cost advantage over the incumbent:

Assumption 8.1. $p^m(c_E + a) \geq a + c_I$, $\forall a \in [\underline{a}, \overline{a}]$.

Hence, if it would have to serve the market, the entrant could not do it at its monopoly price.

Financial constraints. We follow the long-purse (or deep-pocket) argument by assuming that the entrant is financially constrained and that its survival in the second-period depends on its first-period profit level.[1]

Each firm needs to incur a fixed cost F at the beginning of each period, in order to start production. We assume that both firms have incurred the fixed cost for the first period at the beginning of the game; so they can both compete for consumers. The incumbent has unlimited financial resources so it can use direct finance to incur F in the second period, whereas the entrant has limited capital A. Following Biglaiser and DeGraba [2001], we do not model the financial market in which firms could borrow fundings (see Benoit [1984], Bolton and Scharfstein [1990], or Holmström and Tirole [1997] for a theoretical justification of the long-purse argument). Instead, we assume that the financial market is characterized by information asymmetry and that the entrant's capital is too small to convince investors (see Holmström and Tirole [1997]); hence, the entrant has to rely solely on its own capital A.

We assume that $A = F + \gamma$, with $\gamma \geq 0$, so that the entrant cannot lose 'too much' in the first period if it wants to remain in the market in the second period.[2] If it loses more than γ (i.e., its first-period profit is strictly below $-\gamma$), the entrant will not be able to start the second-period production because its remaining capital would be below F.

Finally, following Biglaiser and DeGraba [2001], we assume barriers to re-entry; that is, if the entrant makes zero sale in the first-period, it cannot re-enter the market in the second period. In a nutshell, the entrant must serve the market without making a too negative profit in the first period. If it does not, the incumbent is a monopolist in the second period.

[1] See Motta [2004], p. 413, for a detailed explanation of the long-purse argument.
[2] We study the case where $A \leq F$ in Section 8.5.

Timing. The regulated access charge is exogenously set by the regulator for the whole game before any firm's decision.[1] The timing of the game is then as follows.

1. First period:
   (a) Both firms simultaneously set their retail prices.
   (b) Then, consumers purchase the product.
   (c) Finally, if E makes a first-period profit equal to or lower than $-\gamma \leq 0$, it leaves the market.
2. Second period:
   (a) I and E (if it remains in the market) simultaneously set their retail prices for the second period.
   (b) Then, consumers purchase the product.

We look for the subgame-perfect Nash equilibrium of this game.

8.3 The equilibrium

We solve the game by backward induction, and start by the second period.

8.3.1 Second period

In the last period of the game, either the incumbent has driven its competitor out of the market and is a monopolist or there is Bertrand competition between firms.

If the incumbent is a monopolist, it earns a profit π_I^m and the entrant earns zero profit. By contrast, if both firms are in the market, there exists a continuum of equilibria, with the entrant E serving the market at price $p_E \in [a+c_E, a+c_I]$. Indeed, both firms would undercut a price larger than $a+c_I$, whereas none of them would like to serve the market at a price below $a+c_E$ (the incumbent prefers

[1] We analyze the case where the regulatory authority sets a time-dependent access charge in Section 8.5.

that its competitor serves the market at a price below $a+c_E$ and the latter would make a negative profit doing so).

Besides, the incumbent will never undercut the entrant when the latter sets a price in the interval $[a+c_E, a+c_I]$. Indeed, for any retail price below $a+c_I$, the incumbent earns a higher profit when operating in the upstream market only than when serving the downstream market itself. However, the incumbent would like the entrant to set the lowest feasible retail price in order to increase demand and its upstream profit. By contrast, the entrant earns a larger profit serving the market at a high retail price. Hence, the entrant serving the retail market at a price p_E with the incumbent earning upstream revenues and setting a retail price slightly above the entrant's one is an equilibrium for any $p_E \in [a+c_E, a+c_I]$.[1]

In what follows, we focus on the case where the market is served at the entrant's preferred price (i.e., $p_E = a+c_I$), in order to cancel any umbrella effect on welfare. Therefore, when there is no squeeze in the first period, the incumbent's second-period profit is $\pi^{NS} \equiv (a-c_u)D(a+c_I)$, whereas the entrant's profit equals $\pi^E \equiv (c_I - c_E)D(a+c_I)$. We study the other cases, when the equilibrium price is not $p_E = a+c_I$, in a robustness check in Section 8.5.

We now turn to analyzing the firms' first-period strategies.

8.3.2 First period

In the first period, the incumbent decides whether or not to engage in a margin squeeze.

No margin squeeze. When the incumbent does not undertake a conduct that squeeze its competitor out of the market, the game is exactly as in the second period. In this case, the incumbent and its competitor earn π^{NS} and π^E, respectively.

Without margin squeeze the entrant always remains in the market as we have $\pi^E \geq 0 \geq -\gamma$, because we assumed that $c_E \leq c_I$.

[1] The existence of a continuum of equilibria is a standard result in the literature (see, e.g., Choné, Komly and Meunier [2010]). See also Choi and Stefanadis [2001] and Carlton and Waldman [2002] for a similar result in horizontally-related markets. Finally, note that if we had $c_E > c_I$, the incumbent would always serve the market at price $a+c_E$.

Finally, over the whole game, the incumbent earns the following profit when it does not engage in a margin squeeze:

$$\Pi^{NS} = (1+\delta)\pi^{NS}. \tag{8.1}$$

Margin squeeze. When the incumbent undertakes a margin squeeze, it sets the squeezing price, which is the highest price that the entrant cannot undercut while making a first-period profit larger than or equal to $-\gamma$. Therefore, the squeezing price, $\hat{p}$, is defined by:

$$(\hat{p} - (a + c_E))D(\hat{p}) = -\gamma. \tag{8.2}$$

We can state the following result:

Proposition 8.1. *The squeezing price $\hat{p}$ exists, is unique, and is lower than $a + c_E$.*

Proof. The profit function $\pi(p; a + c_E) = (p - (a + c_E))D(p)$ is strictly concave. Hence, we have $\lim_{p\to-\infty} \pi(p; a+c_E) = -\infty$ if there is no vertical asymptote, and $\lim_{p\to p_0} \pi(p; a + c_E) = -\infty$ if there is one at p_0. Moreover, $\pi(a + c_I; a + c_E) > 0$. Therefore, there exists a unique (possibly negative) price $\hat{p}$ which cannot profitably be undercut by the entrant for which $(\hat{p} - (a + c_E))D(\hat{p}) = -\gamma$, with $\gamma \geq 0$. Furthermore, we have $\hat{p} \leq a + c_E$, because $\pi(a + c_E; a + c_E) = 0$ and it must be that $(\hat{p} - (a + c_E))D(\hat{p}) \leq 0$. □

When it undertakes a margin squeeze, the incumbent earns the first-period profit $\pi^S \equiv (\hat{p} - (c_u + c_I))D(\hat{p})$. As the profit function is concave and $\hat{p} \leq a + c_I < p^m(c_I + c_u)$, we have $\pi^S \leq \pi^{NS}$. Hence, it is costly for the incumbent to undertake a margin squeeze; when it does so, its first-period profit is lowered. When it undertakes a margin squeeze against its competitor, the incumbent's two-period profit is:

$$\Pi^S = \pi^S + \delta\pi_I^m. \tag{8.3}$$

In what follows, we make the following assumption:

Assumption 8.2. *$\hat{p}$ is continuous and twice-differentiable in a.*

Margin squeeze incentive. Having calculated the incumbent's profits under squeeze and no-squeeze decisions, we can determine its incentive to abuse of its dominant position to drive its competitor out of the market. We call H the incumbent's incentive to engage in a margin squeeze. From equations (8.1) and (8.3), we have:

$$\begin{aligned} H &\equiv \Pi^S - \Pi^{NS}, \\ &= \pi^S + \delta\pi_I^m - (1+\delta)\pi^{NS}. \end{aligned} \tag{8.4}$$

8.4 Impact of the access charge on the incentive to engage in a margin squeeze

We now analyze the impact of the access charge on the incentive to engage in a margin squeeze. We have:

$$\frac{\partial H}{\partial a} = \frac{\partial \hat{p}}{\partial a}\frac{\partial \pi^S}{\partial \hat{p}} - (1+\delta)\frac{\partial \pi^{NS}}{\partial a}, \tag{8.5}$$

with $\partial\pi^S/\partial\hat{p} = D(\hat{p}) + (\hat{p} - c_u - c_I)D'(\hat{p})$, and $\partial\pi^{NS}/\partial a = D(a + c_I) + (a - c_u)D'(a + c_I)$.

The first term on the right-hand side of equation (8.5) corresponds to the cost-reduction effect, that is, the impact of the access charge on the cost of undertaking a margin squeeze. The second term in the equation represents the upstream-profit effect, that is, the impact of the access charge on upstream profits.

8.4.1 The effect of the access charge on the squeezing price

The derivative of the squeezing price with respect to the access charge appears in equation (8.5). From equation (8.2), we have:

$$\begin{aligned} \frac{\partial \hat{p}}{\partial a} &= [1 + \frac{\hat{p} - (a + c_E)}{\hat{p}}\epsilon(\hat{p})]^{-1}, \\ &= [1 - \frac{\gamma\epsilon(\hat{p})}{\hat{p}D(\hat{p})}]^{-1}, \end{aligned} \tag{8.6}$$

where $\epsilon(\hat{p}) \equiv \hat{p}D'(\hat{p})/D(\hat{p})$ is the elasticity of demand evaluated at the squeezing price $\hat{p}$.

$\partial\hat{p}/\partial a$ is the rate at which a change in the access charge is passed through in the incumbent's squeezing price $\hat{p}$. From equation (8.6), we see that this rate depends on the entrant's price-cost margin and the demand elasticity, both evaluated at $\hat{p}$. Also, it can be expressed as a function of the survival loss γ, the demand elasticity, and the revenue at the squeezing price.

This rate is equivalent to an out-of-equilibrium pass-through rate, keeping profit constant (at the survival-loss level γ). Note that it is different from the usual pass-through rate in the literature, which is defined at the profit-maximizing price and that depends on second-order properties of the demand function (see, e.g., Bulow and Pfleiderer [1983]).

As $\hat{p}$ is twice-differentiable, $\partial\hat{p}/\partial a$ exists and is continuous for all a. From equation (8.6), we have $\partial\hat{p}/\partial a \in (0,1]$; that is, the squeezing price always increases in the access charge.

8.4.2 The effect of the access charge on the incentive to undertake a margin squeeze

As the profit function is strictly concave, and as $\hat{p} \leq a + c_I$, we have $\partial\pi^S/\partial\hat{p} \geq \partial\pi^{NS}/\partial a > 0$. As $\partial\hat{p}/\partial a \in (0,1]$, we find that the cost-reduction effect $\partial\hat{p}/\partial a * \partial\pi^S/\partial\hat{p}$ might be below or above $\partial\pi^{NS}/\partial a$, the upstream-profit effect component for the first-period only.

We define the following condition:

Condition 8.1.
$$\frac{\partial\hat{p}}{\partial a}\frac{\partial\pi^S}{\partial\hat{p}} > \frac{\partial\pi^{NS}}{\partial a}.$$

We can now state our main result.

Proposition 8.2. *For a given a there exists a unique $\delta^*(a) \geq 0$ such that the incentive to undertake a margin squeeze decreases in the access charge for all $\delta > \delta^*(a)$, and increases in the access charge otherwise. Moreover, when Condition 8.1 holds for a given a, $\delta^*(a) > 0$; otherwise, $\delta^*(a) = 0$.*

Proof. First, note that $\partial\hat{p}/\partial a$, $\partial\pi^S/\partial\hat{p}$, and $\partial\pi^{NS}/\partial a$ are all positive and finite, and that they do not depend on δ. Therefore, $\partial H/\partial a$ is continuous and decreasing in δ, for a given a. Second, when Condition 8.1 does not hold, $\partial H/\partial a$ is negative for any $\delta \geq 0$. Therefore, $\delta^*(a) = 0$. When Condition 8.1 holds, $\partial H/\partial a$ is positive at $\delta = 0$, but $\lim_{\delta \to +\infty} \partial H/\partial a = -\infty$. As $\partial H/\partial a$ is monotone and continuous in δ, there is strictly one positive $\delta^*(a)$ such that $\partial H/\partial a|_{\delta=\delta^*(a)} = 0$. In this case, we find that $\delta^*(a) = (\partial \hat{p}/\partial a * \partial \pi^S/\partial \hat{p})/(\partial \pi^{NS}/\partial a) - 1$. We have $\partial H/\partial a < 0$ when $\delta > \delta^*(a)$, and $\partial H/\partial a \geq 0$ otherwise. □

On the one hand, an increase in the access charge raises the incumbent's upstream revenues when it serves its downstream competitor, and this upstream-profit effect makes margin squeeze less likely. On the other hand, the incumbent's squeezing price $\hat{p}$ increases in the access charge, and this lowers the incumbent's cost to engage in a margin squeeze. This is the cost-reduction effect of an increase in the access charge.

Proposition 8.2 demonstrates that the incentive to engage in a margin squeeze might be increasing in the access charge. When $\partial \hat{p}/\partial a$ is high enough and the discount factor δ is low enough (i.e., below the threshold $\delta^*(a)$), the incentive to behave predatorily increases in the access charge. Indeed, the cost-reduction effect only occurs in the first-period, when the incumbent undertakes a margin squeeze, whereas the upstream-profit effect takes place in both periods. Therefore, the cost-reduction effect may overcome the upstream-profit effect when the discount factor is low enough. This result differs from the one from Biglaiser and DeGraba [2001]. It shows that a regulatory authority may induce anticompetitive conducts by raising the access charge. Therefore, a regulatory authority should carefully monitor possible anticompetitive pricing conducts when increasing the price of the upstream input.

What drives the difference between our result and the one in Biglaiser and DeGraba [2001]? In their model, they assume no discounting and a covered market (even though firms face a downward sloping demand from each consumer), and they find that the incumbent's incentive to undertake a margin squeeze always decreases in the access charge. However, their result cannot be generalized if we introduce a discount factor different from 1 in their model. This is because, for some values of the discount factor, their model does not allow to state whether the incentive to undertake a margin squeeze increases or decreases in the access charge. The model we use is different and it allows us to state a clear-cut result for any discount factor.[1]

However, the result stated in Proposition 8.2 does not tell us when an incumbent would actually squeeze its competitor. For instance, when $\delta = 0$, the incumbent would always serve the downstream entrant because $H < 0$ according to equation (8.4), even if the incentive to engage in a margin squeeze increases in the access charge.

Note that the threshold discount factor $\delta^*(a)$ might be above 1. Even though this is not widespread in the literature, discount factors exceeding 1 are relevant. For instance, as explained by Laffont and Tirole [1987], the "accounting period in the second production stage might exceed that for the first production stage." Note also that the results from Proposition 8.2 are only valid for a given access charge. However, Proposition 8.3 below and its corollary provide an extension of the main result to all a.

Proposition 8.3. *When $\delta > \max_a\{\delta^*(a)\}$ (resp., $\delta < \min_a\{\delta^*(a)\}$), the incentive to undertake a margin squeeze always decreases (resp., increases) in the access charge.*

Proof. We know that $\partial\hat{p}/\partial a$, $\partial\pi^S/\partial\hat{p}$, and $\partial\pi^{NS}/\partial a$ are continuous in a. Hence, $\partial H/\partial a$ is also continuous in a. Therefore, by continuity, if the incentive to engage in a margin squeeze decreases (resp., increases) in a for any given a, it decreases (resp., increases) in a. From Proposition 8.2, if δ is above (resp., below) $\max_a\{\delta^*(a)\}$ for any $a \in [\underline{a}, \overline{a}]$, the incentive to undertake a margin squeeze always decreases (resp., increases) in the access charge. $\square$

Corollary 8.1. *When Condition 8.1 never holds, for any $a \in [\underline{a}, \overline{a}]$, the incentive to undertake a margin squeeze always decreases in the access charge.*

[1] We focus on a framework with a more efficient entrant and linear price competition between firms selling homogeneous products, whereas Biglaiser and DeGraba [2001] solve a model with equally-efficient firms, two-part tariffs at the retail level, and horizontal differentiation. Besides leading to more general results, our choices allow us to fit to the imputation test (i.e., the test $p \geq a + c_I$), widely used in competition policy to disentangle margin squeeze conducts from fair competition. The test postulates linear price competition between firms selling homogeneous products. When product differentiation is more relevant to a particular case, the above test should be adjusted, just as the Areeda-Turner test for predation should be adjusted in such a case (see Spector [2001, 2008]). Finally, as we explained in the previous section, the cost advantage of the entrant allows it to serve the downstream market.

Proof. When Condition 8.1 does not hold, we have $\delta^*(a) = 0$, from Proposition 8.2. Hence, if Condition 8.1 is not satisfied for any a, then $\delta \geq \delta^*(a)$ for all a. The rest follows from Proposition 8.3. □

Proposition 8.3 and Corollary 8.1 give the necessary and sufficient conditions for which the incentive to engage in a margin squeeze *always* decreases (or increases) in the access charge. As an example, suppose that $c_E = 0$ and that the demand curve is almost flat on the interval $[\hat{p}(\underline{a}), \overline{a} + c_I]$. This means that the demand is almost constant for any price between $\hat{p}(\underline{a})$ and $\overline{a} + c_I$. Therefore, we have $\partial\hat{p}/\partial a \approx 1$, and Condition 8.1 holds. Hence, if δ is low enough, the incentive to engage in a margin squeeze increases in the access charge.

This result means that when the above conditions are satisfied, and Proposition 8.3 applies, a regulatory authority could in principle know whether increasing the access charge would lower or increase the incumbent's incentive to behave predatorily.

8.5 Robustness and extensions

In this section, we perform some robustness checks regarding our assumptions, and provide some extensions to our baseline model.

8.5.1 Other equilibrium prices

When the incumbent does not squeeze the entrant, we explained that the latter serves the market at a price $p_E \in [a + c_E, a + c_I]$. In our model we assumed that the equilibrium price was the entrant's preferred price, that is, $p_E = a + c_I$. If we relax this assumption the incumbent's profit when there is no squeeze, π^{NS}, changes, as we have $\pi^{NS} = (a - c_u)D(p_E)$.

For example, if the equilibrium price is the incumbent's preferred price, that is $p_E = a + c_E$, we have $\pi^{NS} = (a - c_u)D(a + c_E)$ and $\partial\pi^{NS}/\partial a = D(a + c_E) + (a - c_u)D'(a + c_E)$. As $\hat{p} \leq a + c_E$, we can easily see that we still have $\partial\pi^S/\partial\hat{p} \geq \partial\pi^{NS}/\partial a$, with $\partial\pi^S/\partial\hat{p} = D(\hat{p}) + (\hat{p} - c_u - c_I)D'(\hat{p})$:

$$\begin{aligned} \frac{\partial\pi^S}{\partial\hat{p}} &\geq D(a + c_E) + (a + c_E - c_u - c_I)D'(a + c_E), \\ &\geq \frac{\partial\pi^{NS}}{\partial a} - (c_I - c_E)D'(a + c_E) \geq \frac{\partial\pi^{NS}}{\partial a}. \end{aligned} \tag{8.7}$$

Therefore, our results remain valid as Condition 8.1 may hold, which is a necessary condition for the incentive to undertake a margin squeeze to increase in the access charge.

However, in most cases where $p_E \in (a+c_E, a+c_I)$ is undetermined, Condition 8.1 may never hold. This depends on the derivative of the equilibrium price when there is no squeeze with respect to the access charge, i.e., $\partial p_E/\partial a$.

8.5.2 The long-purse argument and profit hurdles

We argued that a margin squeeze is a feasible strategy, using the long-purse argument. We considered that both firms can incur a loss in the first-period, but that the entrant's one is limited because of financial constraints.[1] We simplified the argument by assuming that the entrant's capital A equals $F+\gamma$, with $\gamma \geq 0$, so that its loss cannot be greater than $-\gamma$, or it should exit the market.

We could also consider a framework where the entrant's capital is such that $A = F - \gamma$, with $\gamma \geq 0$. In this framework, which is closer to that of Biglaiser and DeGraba [2001], the entrant has to make a first-period profit that is above a positive profit hurdle γ in order to remain in the market.

In this case, the equilibrium where the incumbent undertakes a margin squeeze is modified. Indeed, in contrast to our main result where the incumbent serves the market at a price below $a + c_E$, there is a continuum of equilibria with the entrant serving the market at a price $p_E \in [a + c_E, \tilde{p}]$, such that:

$$(\tilde{p} - (a + c_E))D(\tilde{p}) = \gamma, \tag{8.8}$$

with the incumbent being a monopolist in the second period. Indeed, for any price $p_E \in [a + c_E, \tilde{p}]$, the entrant serves the market in the first period but its profit is too small to allow it to remain in the market in the second period.

As previously, we assume that the entrant can survive in the second period when there is no squeeze (i.e., when the equilibrium price is $a + c_I$). Therefore, we have $\tilde{p} \leq a + c_I$.

Even though the entrant serves the market when $p_E \in [a + c_E, \tilde{p}]$, its first-

[1]Note that, the entrant incurs no loss at the equilibrium apart from the fixed cost F incurred at the beginning of the first period, because it does not sell any product when there is a margin squeeze, as the game is of perfect information.

period profit would not allow it to survive in the second period. The incumbent earns the upstream profit $\tilde{\pi}^S \equiv (a - c_u)D(p_E)$ in the first period, and the monopoly profit in the second period.

However, the incumbent does not incur any loss in this case. Instead, its profit when squeezing is even greater than the profit it earns when it does not engage in a margin squeeze in the first period, i.e., $\tilde{\pi}^S \geq \pi^{NS}$. This is because we assumed that the non-squeezing equilibrium price is the entrant's preferred one, $a + c_I$; and, hence, a margin squeeze allows the incumbent to benefit from a lower equilibrium price. Therefore, when $A \leq F$, a margin squeeze occurs simply through a normal profit maximization behavior from the incumbent, which should not be defined as anticompetitive. This case should not be considered as a predatory strategy, because there is no loss nor foregone profit from the incumbent in the first period.

8.5.3 The effect of the access charge on the entrant's financial constraints

If we suppose that the entrant's financial constraints are set after the regulatory authority has determined the access charge, the financial constraint parameter γ is a function of the access charge a.[1] In this case, the incumbent's squeezing price depends on the derivative of the constraints with respect to the access charge, $\partial\gamma/\partial a$, and we have:

$$\frac{\partial \hat{p}}{\partial a} = (1 - \frac{\partial \gamma}{\partial a}\frac{1}{D(\hat{p})})[1 + \frac{\hat{p} - (a + c_E)}{\hat{p}}\epsilon(\hat{p})]^{-1}. \tag{8.9}$$

When the entrant's constraints increase in the access charge, i.e., when $\partial\gamma/\partial a < 0$, an increase in the access charge reduces the entrant's capital. In this case, the impact of the access charge on the squeezing price is greater than in the case where the constraints do not depend on the access charge (i.e., $\partial\gamma/\partial a = 0$), and, hence, Condition 8.1 is more easily satisfied and the discount factor threshold is increased.

By contrast, when the entrant's constraints decrease in the access charge, i.e.,

[1] Biglaiser and DeGraba [2001] also analyze the effect of the access charge on the entrant's financial constraints. They find that when the entrant's profit hurdle increases in the access charge, the incumbent's incentive to undertake a margin squeeze increases in the access charge if the latter is high enough.

when $\partial\gamma/\partial a > 0$, an increase in the access charge increases the entrant's capital, and the impact of the access charge on the squeezing price is lower than in the case where the constraints do not depend on the access charge.

8.5.4 Time-dependent regulation

Suppose that the regulatory authority cannot commit to the second-period access charge at the beginning of the game. Therefore, the access charges in the first and second periods might differ. We denote by a_i the access charge in period i, with $i = \{1, 2\}$.

When there is no squeeze, the incumbent's total profit is $\Pi^{NS} = \pi^{NS}(a_1) + \delta\pi^{NS}(a_2)$, and, hence, $H = \pi^S + \delta\pi_I^m - [\pi^{NS}(a_1) + \delta\pi^{NS}(a_2)]$. Let us assume that there is a projection from a_1 to a_2, so that a_2 is a function of a_1, and that $a_2(a_1)$ is twice-differentiable. Hence, we have:

$$\frac{\partial H}{\partial a_1} = \frac{\partial \hat{p}}{\partial a_1}\frac{\partial \pi^S}{\partial \hat{p}} - \frac{\partial \pi^{NS}}{\partial a_1} - \delta\frac{\partial a_2}{\partial a_1}\frac{\partial \pi^{NS}}{\partial a_2}. \tag{8.10}$$

First, suppose that $\partial a_2/\partial a_1$ is positive. Then, for a given a_1, the results from Proposition 8.2 remain valid, as the incentive to engage in a margin squeeze increases (resp., decreases) in the access charge for any δ lower (resp., higher) than the discount factor threshold. Only this threshold is modified, and the new threshold is:

$$\dot{\delta}(a_1) = \max\{0; \frac{\frac{\partial \hat{p}}{\partial a_1}\frac{\partial \pi^S}{\partial \hat{p}} - \frac{\partial \pi^{NS}}{\partial a_1}}{\frac{\partial a_2}{\partial a_1}\frac{\partial \pi^{NS}}{\partial a_2}}\}. \tag{8.11}$$

Second, suppose that $\partial a_2/\partial a_1$ is negative. This means that if the regulatory authority increases the access charge in the first period, it will decrease this price in the second period, and reciprocally. In this case, the results from Proposition 8.2 are reversed and the incentive to undertake a margin squeeze increases (resp., decreases) in the access charge for all $\delta > \dot{\delta}(a_1)$ (resp., $\delta < \dot{\delta}(a_1)$). Moreover, when $\partial\hat{p}/\partial a_1 * \partial\pi^S/\partial\hat{p} > \partial\pi^{NS}/\partial a_1$ for a given a_1, we have $\dot{\delta}(a_1) = 0$; otherwise, $\dot{\delta}(a_1) > 0$.

8.5.5 Margin squeeze incentive with bypass

We considered that the incumbent owns an essential facility. In some markets, however, essential facilities can be bypassed as time goes by and new technologies appear. For instance, in the telecommunications industry, the copper local loop (the 'last mile' of the network) is still considered as an essential facility for providing ADSL services, even though some firms bypass this bottleneck by investing in fiber local access networks in highly populated areas.

Let us assume that the entrant can bypass the incumbent's network in the second period, and that, if it does so, its upstream marginal cost equals the incumbent's one, c_u. Hence, if it bypasses the incumbent's network, the entrant serves the market as it is more efficient than the incumbent ($c_E \leq c_I$). Therefore, the incumbent makes zero profit. If we suppose that the entrant bypasses the incumbent's input with probability $1 - \theta$ in the second period, this would change the incumbent's profit when it does not squeeze.[1] Indeed, we would have $\Pi^{NS} = (1 + \delta\theta)\pi^{NS}$; and, hence:

$$H = \pi^S + \delta\pi_I^m - (1 + \delta\theta)\pi^{NS}. \tag{8.12}$$

Our results may depend on the derivative of the probability of bypass with respect to the access charge, $\partial(1-\theta)/\partial a$. Indeed, the probability of bypass usually increases in the access charge, as a high access charge reduces the entrant's profit without bypass (i.e., $\partial\theta/\partial a \leq 0$). In order to analyze the incentive to engage in a margin squeeze, we define $\Theta \equiv \theta + (\partial\theta/\partial a * \pi^{NS})/(\partial\pi^{NS}/\partial a)$ as the overall effect of bypass.

All of our results remain valid when $\Theta > 0$, with a new threshold $\tilde{\delta}^*(a) = \max\{0; \delta^*(a)/\Theta\}$. Besides, when $\partial\theta/\partial a \leq 0$, we have $\Theta \leq 1$, and the incentive to undertake a margin squeeze increases in the access charge for a larger range of values of the discount factor δ when bypass is feasible, when Condition 8.1 is satisfied.

Furthermore, when an increase in the access charge makes bypass a much more feasible option, that is, when $\partial\theta/\partial a$ is negative enough such that $\Theta \leq 0$, the result is even simpler. Indeed, in this case, the incumbent's incentive to

[1] Similarly, $1-\theta$ might also be the incumbent's first-period belief of the entrant's probability of bypass in the second period.

undertake a margin squeeze increases in the access charge when Condition 8.1 is satisfied, for any discount factor δ.

8.6 Conclusion

We analyzed the impact of a regulated access charge on a vertically-integrated firm's incentive to undertake a margin squeeze. We demonstrated that the incentive to engage in a margin squeeze may either increase or decrease in the access charge, which is in contrast to the existing literature. Therefore, when raising the price of the upstream input, a regulatory authority might increase the incumbent's incentive to abuse of its dominant position.

In particular, we showed that a low-enough discount factor could lead the incumbent's incentive to undertake a margin squeeze to increase in the access charge. In this case, an increase in the access charge leads to a small upstream-profit effect, and the cost-reduction effect may dominate.

Our general results also depend on the price-cost margin of the entrant and the elasticity of demand evaluated at the squeezing price. We also explained why our results are robust to different equilibrium prices and to a regulation that evolves along time, and how they depend on the entrant's probability of bypass in the second period.

In addition to this analysis of the incentive to undertake a margin squeeze when the access charge is regulated, it would be of interest to study this incentive in an unregulated environment (as in Salop and Scheffman [1983, 1987], Salop [2010], or Chen [2013]); or in an environment regulated by ex-post competition law (see Choné, Komly and Meunier [2010] and Chen [2013]).

Part VI

Conclusion

Chapter 9

Conclusion

In this last chapter, we briefly summarize our results and give directions for further research projects.

9.1 Review of the main results

Below, we provide a brief summary of our main results.

9.1.1 Regulation in the telecommunications industry

In Chapter 3, we tested the ladder of investment hypothesis. The ladder of investment is a regulatory approach, widely referred to in the European telecommunications regulatory framework. This regulation aims at resolving the static vs. dynamic efficiency trade-off by providing a special type of one-way access regulation to entrants within a given technology infrastructure, Digital Subscriber Line (DSL). Its ultimate goal is to favor entrants' investments in the long run. We demonstrated that the ladder of investment hypothesis was not validated, as a higher number of local-loop unbundled lines does not induce a higher number of new infrastructure lines built by entrants. However, we provide some evidence that the ladder of investment approach allows entrants to invest progressively within a given technology infrastructure owned by the incumbent (DSL), up to the local loop.

Chapter 3 outlines why it is difficult to implement ex-ante regulatory rules to solve the static vs. dynamic efficiency trade-off in the telecommunications industry. Indeed, effects of ex-ante regulation may be difficult to foresee without a deep economic analysis, which might be lengthly or unfeasible ex-ante because of uncertainty.

In Chapter 4, we studied when and how do European regulatory authorities use ex-ante margin squeeze tests in order to set access rules in telecommunications markets. We built a theoretical framework that allowed us to benchmark regulatory authorities' choices in modeling Reasonably Efficient Operators (REOs) in margin squeeze tests. We found that some implementation choices are very similar across authorities' decisions, whereas some others display a strong heterogeneity.

In Chapter 4 we showed that further guidance at the European level might be needed for harmonizing regulations between countries. Indeed, some regulatory authorities favor entry in the short run through their implementation choices, whereas some others are more conservative, often with a view to favor the incumbent's long-run investment incentives.

To summarize, in Part III we demonstrated that a major difficulty for ex-ante regulatory intervention in telecommunications markets in Europe is related to the ex-ante unforeseeable nature of regulatory rules and of the outcomes of these rules. We argue that this problem might be (partially) solved either by using deeper ex-ante economic analyses, or greater guidance or communication between ex-ante regulatory authorities for experience-sharing.

9.1.2 Competition policy in the ICT sector

In Chapter 5 we showed that the sole presence of switching costs in a monopolized market may provide sufficient incentives for a profitable bundling strategy. We motivated this analysis with an example from mobile telecommunications markets, and demonstrated that a high level of switching costs might allow a dominant firm to earn higher profits when it bundles its products together.

The current policy framework used to analyze possible anticompetitive effects of bundling may be incomplete as it does not take into account the strategy we illustrate in Chapter 5. This is so because competition policy relies on economic models and on the case law, which does not always take into account the typical features of the ICT sector.

In Chapter 6, we demonstrated that the recent antitrust investigations in the ebook markets, in the United States and in the European Union, failed to take into account an important feature of these markets; namely that access to ebooks is only available after the purchase of a reading device. We established that this specific industry feature induces strategic effects which play an important role in the analysis of the impact of firms' conducts, and that these strategic effects have been overlooked in the antitrust investigations.

To summarize, in Part IV we demonstrated that ex-post intervention in the ICT sector may face implementation difficulties as competition policy relies heavily on past decisions and case law, which may have been made regardless of the ICT sector specificities. Hence, such intervention needs to be carefully implemented, by using particular analysis and ad-hoc theoretical models for instance. By contrast, the commitment and foreseeable nature of ex-post competition policy, due to case law and the fact that competition policy heavily relies on past decisions, is one of its main strengths.

9.1.3 The interplay between regulation and competition policy

In Chapter 7 we analyzed margin squeeze as an entry-deterrence strategy in an ex-ante regulated market. We demonstrated that a vertically-integrated incumbent might undertake a margin squeeze in order to deter a more efficient downstream competitor, as there is a threat that this competitor invests in its upstream facilities in the long-run. The economic strategy of margin squeeze in a regulated market we illustrated thus follows the defensive leverage argument.

In Chapter 7 we also showed that a margin squeeze in an ex-ante regulated market only occurs when the access charge is set above cost. If it is not regulated or regulated at cost, a margin squeeze never occurs. Indeed, in this case the vertically-integrated incumbent either sets a high access charge and a high retail price for the entrant to serve the retail market, or engages in below-cost predatory pricing, or undertakes a refusal-to-deal. Therefore, standard competition policy rules defining predatory pricing and refusal-to-deal might be inappropriate to deter anticompetitive conducts in a market with ex-ante regulation.

In Chapter 8 we studied how ex-ante regulation impacts a dominant firm's anticompetitive conduct. We showed that an increase in the access charge can increase or decrease the vertically-integrated incumbent's incentive to undertake a margin squeeze, as it simultaneously increases the incumbent's upstream profit when it sells inputs to the downstream entrant, and lowers the cost of abusing of its dominant position. When the discount factor is low enough, the latter effect may dominate and an increase in the access charge can increase the incumbent's incentive to undertake a margin squeeze.

Chapter 8 highlights the relationship between ex-ante regulation and ex-post competition policy, and more precisely, the potential negative impact of the former on the latter. Indeed, if both regulations are not well-coordinated, all positive effects of ex-ante and ex-post regulation might disappear because of regulation-induced anticompetitive conducts.

To summarize, in Part V we studied problems related to the application of ex-post competition policy in ex-ante regulated markets. We showed that ex-ante regulation may become a concern for ex-post competition policy as it can modify a well-known abuse (as predatory pricing or refusal-to-deal) into a new anticompetitive conduct (margin squeeze) to which case law might be unadapted. In addition, ex-ante regulation may have a strong impact on a dominant firm's incentive to undertake an anticompetitive conduct.

9.1.4 General perspectives

In this thesis, we highlighted some positive and negative effects of both ex-ante and ex-post regulation. In Part III we showed that ex-ante regulation typically faces some reliability problems, because of its non-foreseeable nature and of the wide range of applications of regulatory rules. By contrast, the ability of ex-ante regulation to adapt to market specificities is generally beneficial.

In Part IV we explained why the lack of flexibility of ex-post competition policy introduces some difficulties for analysis and may misguide decisions when competition policy is applied in industries which have specific organizations, such as in the ICT sector. However, the ex-ante predictability of ex-post rules due to reliability over past decisions and case law allows ex-post competition policy to avoid –or at least minimize– the 'trial and error' effect one can find in ex-ante regulation.

Therefore, the strengths of ex-ante regulation correspond to the weaknesses of ex-post regulation, and *vice-versa*. Indeed, some of the main problems of ex-ante regulation, i.e., the non-foreseeable nature of ex-ante rules and the wide range of their possible applications, correspond to the strength of ex-post competition policy, in particular because of the importance of case law in ex-post regulation. By contrast, we also showed that the reverse holds regarding the adaptability of regulatory rules to market specificities.

This link between ex-ante and ex-post advantages and weaknesses is mainly due to three specific features of both types of regulation. First, the commitment power of ex-post competition policy is quite stronger than the one of ex-ante regulation, as competition authorities have to build on the past case law whereas NRAs are more flexible in implementing regulatory rules to particular cases. Second, ex-ante regulation is generally sector-specific, whereas ex-post competition policy is not. This also makes ex-ante regulation more flexible than ex-post regulation, as regard to special characteristics of the industry. Finally, the unforeseeable nature of ex-ante regulatory outcomes might be due to regulatory capture, as it impacts ex-ante regulation more fiercely than ex-post competition policy. This might explain, for instance, why we observed important differences in the implementation of ex-ante margin squeeze tests between NRAs in Chapter 4.

One might wonder whether problems or benefits add up when enforcing ex-post competition policy in ex-ante regulated markets. In Part V we studied such interplay between both types of regulation. We showed that ex-ante regulation may induce anticompetitive conducts or increase the incentive for a dominant firm to undertake some, notably due to the lack of flexibility of ex-post competition policy. As ex-ante regulatory authorities may not have sufficient tools to prevent all anticompetitive conducts their regulations can induce, specific ex-post rules should be implemented in ex-ante regulated markets. This is what we argued for in Chapter 7 in the case of margin squeeze, hence defending the 'European view' against the 'U.S. view,' the latter typically forbidding ex-post intervention in ex-ante regulated markets.

9.2 Future projects

We introduce below some ideas for future research, either by considering recent regulatory debates in the ICT sector, competition policy in the telecommunications industry in non-regulated markets, and possible future ex-ante or ex-post regulation of reputation systems on the internet.

9.2.1 Regulation in the ICT sector: Net neutrality and advertising

Since the mid-2000s, the net neutrality debate has received a lot of attention from practitioners, policymakers, and academics in the communications industry. Net neutrality, broadly defined, means that every internet content provider (CP) should be treated equally by internet service providers (ISPs), which own the network infrastructures connecting to final consumers.[1] A regime where net neutrality is not imposed by public bodies would allow ISPs to charge CPs for providing their services to consumers, sometimes through a quality-tariff menu, or to charge consumers different prices according to the content provider they reach.

Even though a vast literature has burgeoned, addressing the impact of net neutrality on investment in network infrastructures subject to congestion (Choi and Kim [2010], Economides and Hermalin [2013], Krämer and Wiewiorra [2012], Bourreau, Kourandi and Valletti [2012]), on innovation from CPs (Bourreau, Kourandi and Valletti [2012], Reggiani and Valletti [2012]), or on the CPs' business model (Jullien and Sand-Zantman [2012]), the debate remains vivid in the industry, as some important questions are still unresolved.

In most of the models cited above, advertising is a source of revenues for CPs. Nevertheless, these models do not consider advertising as a nuisance for consumers; in other words, the consumers' utilities do not directly depend on the advertising level. One justification of this assumption is that online advertising mainly benefits consumers, for instance because it leads to better matching.

However, in traditional media markets (TV, radio, newspapers) it is well-

[1] See, e.g., Economides and Tåg [2012] for an introduction to the net neutrality debate.

known that consumers might also be reluctant to advertising (see, e.g., Anderson and Coate [2005]). In the internet market, this effect might even be stronger than for traditional media markets because of consumers' privacy concerns related to targeted advertising (Goldfarb and Tucker [2011]). Therefore, in some cases, the consumers' utility directly may decrease in the advertising level.

In this regard, there is a need for a better understanding of the relationship between net neutrality and the provision of advertising in internet markets, when consumers consider advertising as a nuisance. This trade-off might be analyzed within a theoretical model.

9.2.2 Competition policy in the telecommunications industry: Margin squeeze in unregulated industries

Margin squeeze and refusal-to-deal can occur in both regulated and unregulated markets. In this thesis, we studied margin squeeze conducts in ex-ante regulated markets, and we based our motivation on recent case law. However, some of the recent case law also considers margin squeeze in markets which are not subject to ex-ante regulation.

For instance, the case *Konkurrensverket v. TeliaSonera Sverige AB* was a request for preliminary ruling from the Stockholm District Court to the European Court of Justice.[1] The Swedish court was asked by the Swedish competition authority (the Konkurrensverket) to fine the Swedish telecommunications incumbent, TeliaSonera, for setting a margin squeeze in the broadband market from April 2000 until January 2003. At the time of the abuse, TeliaSonera had no regulatory obligation to supply its competitors at the upstream level, but did it on a voluntary basis. In this case, the European Court notably answered that the absence of any regulatory duty-to-deal at the upstream level has no impact on the question on whether the pricing practice is abusive or not.

As another example, in a recent case, the French Competition Authority's decision in the case *Cogent Communications v. France Télécom* addressed margin squeeze issues in the internet connection peering market. Cogent, an inter-

[1] Case C-52/09, request from the Stockholm District Court to the European Court for preliminary ruling.

national transit operator, whose clients are national Internet Service Providers (ISPs) and Content Providers (CPs), claimed that France Télécom entailed a margin squeeze in the internet connection peering market. France Télécom is a vertically-integrated company in this market, with its own ISP, Orange, and its own transit subsidiary, Open Transit. In order to connect to Orange's customers, Cogent has to connect to Orange's network directly, or through Open Transit's network. Cogent claim was that the free peering exchange points between its own network and Open Transit's network did not guarantee a proper connection, and that, hence, it was forced to accept a paid interconnection with Open Transit to connect to Orange's customers. The case was dismissed by the French Competition Authority and is currently in appeal.[1]

Just as for margin squeeze conducts in regulated industry, there are only few papers studying these conducts (see Salop [2010], and Chen [2013]). Hence, it might be interesting to analyze carefully an incumbent's motivations for undertaking a margin squeeze when it used to serve its competitor on a voluntary basis. Also, having a clear understanding of how margin squeeze conducts should be dealt with by competition authorities, and their differences with refusal-to-deal or predation, would be of great interest.

9.2.3 A need for ex-post or ex-ante regulation? Competing reputation systems on the internet

One of the reasons why internet marketplaces such as eBay or Amazon Marketplace have become so popular is that they have built efficient reputation systems to develop trust between buyers and sellers. Indeed, trust between buyers and sellers constitutes an important asset of peer-to-peer (P2P) markets, as these platforms are subject to adverse selection and moral hazard problems.

In order to overcome the adverse selection and moral hazard problems and to enhance trust, online P2P marketplaces have set reputation systems for buyers to observe sellers' quality or type, based on other buyers' experience about past transactions.

[1]Note that this case is the first to address the interplay between margin squeeze and net neutrality.

Reputation systems are valuable to develop trust between buyers and sellers (see, e.g., Kennes and Schiff [2007], or Cabral [2012a]), and reputation constitutes an important stream of research in the economics of internet markets (Levin [2011]). The theoretical literature on reputation systems mainly built on the effect of underprovision of evaluations (Avery, Resnick and Zeckhauser [1999]), which are a public good, or on seller's or platforms' strategy such as offering rebates to buyers for evaluation reports (Li [2010]).

The empirical literature is more voluminous, notably because online markets such as eBay generally allow researchers to extract an important amount of data. In this regard, the literature is composed of analyses on the effectiveness of a reputation system (Bolton, Katok and Ockenfels [2004]), the value of reputation for sellers (Livingston [2005], Resnick *et al.* [2006]), or the effect of reputation on sales rate and exit (Cabral and Hortacsu [2010]), or on prices and sales in a market with adverse selection (Dewan and Hsu [2004]).

What the literature has not addressed yet is that, in reality, platforms compete with one another, and they all have their own proprietary reputation system. One can conjecture that competition between platforms with proprietary reputation systems have strong impacts on the reputation mechanism and its outcomes. It would be of interest to analyze the impact of reputation systems on consumer lock-in.[1] Also, it would be interesting to consider interconnection between both platforms' reputation systems, or to find the optimal interconnection fee between both reputation systems, or to study the ex-post or ex-ante regulation of such interconnection

This research project is directly related to the current policy debate about privacy concerns in digital (and non-digital) markets, and might help to solve the following questions: Who does own one's reputation (or historical data)? Or, who can decide what information is available to whom?

[1]See Farrell and Klemperer [2007] for a review of the literature on switching costs and lock-in.

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Régulation et politique de la concurrence dans le secteur des TIC : Éssais d'économie industrielle

Germain GAUDIN

RESUME : Cette thèse aborde certaines caractéristiques des politiques de régulation et de la concurrence dans le secteur des Technologies de l'Information et de la Communication (TIC). Plusieurs problématiques de régulation ex-ante sont abordées, traitant de l'investissement dans les infrastructures de réseaux fixes de télécommunications et de la mise en place de tests de ciseaux tarifaires par les autorités de régulation du secteur des télécommunications en Europe. Sont également étudiées différentes problématiques de politique de la concurrence, comme l'impact de la vente liée de produits créant des coûts de changement pour les utilisateurs ou la prise en compte des terminaux d'accès pour l'analyse du marché du livre électronique en droit de la concurrence. Les impacts de la régulation sectorielle sur la politique de la concurrence sont également analysés, avec une application à la définition et la gestion par les autorités de concurrence de la pratique de ciseau tarifaire dans les industries de réseaux. Enfin, cette thèse met en perspective différents avantages et inconvénients des interventions ex-ante et ex-post, respectivement par les autorités de régulation sectorielle et de concurrence.

ABSTRACT : This thesis approaches several distinctive features of regulation and competition policy in the Information and Communications Technology (ICT) sector. It tackles some issues in ex-ante regulation on investment in new fixed telecommunications network infrastructures, and the application of margin squeeze tests by European regulatory authorities in the telecommunications industry. It also analyzes issues related to ex-post competition policy, such as the impact of bundling products with switching costs, or the competition authorities' investigations in the electronic book market. Further analysis on the impact of ex-ante regulation on ex-post competition policy is provided, in particular via studies on the definition of a margin squeeze conduct in network industries, and how competition authorities deal with it. Finally, this thesis evaluates several advantages and weaknesses of both ex-ante regulatory authorities' and ex-post competition authorities' interventions.

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